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HAND BOOK OF FEVERS

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A HANDBOOK OF FEVERS.

J. Campbell McClure, M.D.

To the Memory of

The Late SIR WILLIAM GAIRDNER, K.C.B.,

and

The Late J. B. RUSSELL, M.D.,

the two first Medical Officers of Health

for the City of Glasgow.

Demy 8vo., 450 pp.

A HANDBOOK OF FEVERS

BY

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PAUL B. HOEBER,
69, EAST 59TH STREET,
NEW YORK.

1914.

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PREFACE.

THIS book pretends to be no more than a handbook for the use of students and general practitioners, and the author has endeavoured as far as possible to confine his attention to the more practical aspects of the diseases under consideration, devoting more space to treatment than many will perhaps approve of. Detailed descriptions of the pathological anatomy of the various diseases have been purposely avoided, and only such points in epidemiology and bacteriology have been dwelt upon as seem to be absolutely necessary. Only those tropical diseases have been included in this small volume as may possibly be met with in Great Britain in the ordinary course of practice. Beriberi has been included since, although it is not strictly a febrile disease, it appears to be due to some specific infection, and is not infrequently seen in our larger seaport towns. The inclusion of a chapter on Pellagra has been rendered necessary by the discovery that the disease is prevalent in the United States of America to a degree undreamed of half a dozen years ago, and by the fact that it seems likely that in the next few years a considerable number of cases will be discovered in this country. The disease is unknown to the majority of practitioners in the British Islands, and it is probable that increased knowledge of the symptomatology and course of this interesting disorder will, as was the case in the summer of 1913, lead to the discovery of the disease in areas hitherto unsuspected.

59, Harley Street, W.

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CHAPTER I.

INTRODUCTORY.

The febrile state, to whatever cause it may be due, is characterised by certain general signs and symptoms which are met with almost constantly whenever there is any considerable rise of temperature above the normal. The patient may at the onset of the febrile attack experience a sense of exaltation, of well-being above the normal, and may present a facies suggestion of mental excitement with more or less flushing of the cheeks and unusual brightness of the eye. In other cases the onset of fever may be marked by a sensation of chill, amounting in some cases to an undoubted rigor, with pallor of the face and an appearance of apprehension and uneasiness. In any case, the patient is soon the subject of indefinite malaise, headache, loss of appetite and a general feeling of enfeeblement. He may be quiet and drowsy, or restless and delirious. He feels hot, complains of thirst, may suffer from nausea, may be constipated, or may have slight diarrhœa. The face is flushed more or less generally according to the disease, the eye is usually bright, but sometimes dull and bloodshot, and there is a suggestion of "remoteness" about the expression of the sick person. The pulse and respiration are quickened, in varying proportion to the rise in temperature according to the disease of which the fever is a manifestation. The urine is scanty and high coloured, rich in urates and frequently deficient in chlorides. It is usual now-a-days to consider that fever is the effect of toxins of bacterial origin on the heat-regulating mechanism, so that there is at the same time an increase in heat production, the result of increased metabolic processes, and a decrease in heat-loss, due to the poisoning of

the central vasomotor areas. The increase in the rate of respiration is probably due to two causes—(a) an attempt to aerate blood unduly charged with the waste-products of metabolism, and (b) a poisoning of the respiratory centres, while the increase in heart-rate may be due to a direct inhibition of the vagus, or stimulation of the sympathetic cardiac fibres by the circulating toxins.

Fever is usually described according to its height, and also according to the type of its daily variation. A temperature of 100° F. or over is considered to be febrile, and it is common to call all fever over 105° F. *hyperpyrexia*. In febrile conditions the ordinary daily variation of temperature—slight morning fall and evening rise—is usually preserved. In some few cases, however, the evening temperature is lower than the normal, and it is possible that in such cases this has been the ordinary habit of the individual in health. A fever is called *continued* when the daily variation is only two degrees Fahrenheit or less. It is called *remittent* when the daily variation is over 2° F. and when the lowest point does not fall to normal, while a fever which has a daily variation of more than 2° F. and when the lowest point falls to or below normal is called *intermittent*.

The onset of a fever varies greatly in different cases. Sometimes the invasion is sudden and severe, with a temperature rising to high pyretic or hyperpyretic registers in a few hours, while sometimes the invasion is slow and gradual—days elapsing before the *fastigium* or height of the fever is reached. Similarly the termination of the fever may be sudden and complete in a few hours, or it may be gradual, taking several days to reach the normal. The former is called termination by *crisis*, the latter termination by *lysis*. Before the actual complete termination of a fever, a fall of the temperature to normal, or nearly so, may suddenly occur, but instead of remaining in normal regions the temperature may rise again as suddenly to heights as great or even greater than before the fall. Such an occurrence is termed a *pseudo-crisis*.

Accompanying a crisis it is common to have a great increase in the output of urine, which at this time is often pale

and may contain crystals of uric acid. Sweating is usually profuse, and there may be a tendency to diarrhœa. These "critical discharges" have been observed by the earliest writers on the subject.

In estimating the temperature of a patient certain precautions must be observed. A reliable thermometer is the first essential, and it is wise to have an instrument furnished with a certificate from Kew showing the actual error in its registering. The thermometer should be sensitive, one supposed to register the temperature accurately in 30-60 seconds should be used, but it should be kept in place for some two minutes before reading. The temperature of the axilla, groin, mouth or rectum may be taken, and it must be remembered that the skin of the axilla and groin should be thoroughly dried before the thermometer is introduced. The normal temperature is considered to be 98.4° F. in the axilla or groin, 98.8°—99° F. in the mouth or rectum, but considerable physiological variation is frequently observed. Roughly speaking, a temperature of 97.4°—98.8° F. in the axilla may be considered normal; above that to 100° F. it may be described as *subfebrile*, while 100° F. and over may be reckoned as *febrile*, and below 97.4° F. may be considered *subnormal*. The observer should remain beside the patient while the thermometer is in position to prevent accidental moving of the instrument, or manipulation of it by malingerers and hysterical patients.

It is important to take care as to the hours at which the temperature is taken. Where fever is suspected, it is not enough to take a usual "morning and evening" temperature, at 8 or 9 a.m. and 8 or 9 p.m. Where only two readings are taken, the maximum temperature is often missed and the physician has but little knowledge of the daily variation in the temperature-curve. It is often very difficult in practice to have accurate observations on the temperature made where no trained nurse is in attendance, but in these days, when a clinical thermometer is as common a piece of furniture as a hot-water bag, it is not usually difficult to have a series of fairly dependable observations made by some responsible member of the household. Among the poorer and less

educated classes, the district nurse can usually be relied upon to make a couple of calls a day at hours which, together with visits of the physician, will help towards a reasonably complete series of observations of the temperature. Regularity in the hours of taking the temperature is of the greatest importance. Where possible the temperature should be observed every four hours, 4 a.m., 8 a.m., 12 noon, 4 p.m., 8 p.m., and 12 midnight, or the hours of 2 a.m., 6 a.m., 10 a.m., 2 p.m., 6 p.m., and 10 p.m. may be chosen. The early morning observations at 2 a.m. or 4 a.m. may be omitted if circumstances demand. By these means the temperature is recorded at the same time each day, and it is unlikely that any very important variation will be missed. In certain cases more frequent observations may be necessary or at least advisable. In cases of pulmonary phthisis who do not require to be kept in bed, it is necessary to observe the temperature before and after exercise.

There are certain general principles which underlie the treatment of the febrile state whatever the disease be in which the fever is a symptom. As a result of poisoning by bacterial toxins, tissue waste is abnormally active, and at the same time, the powers of secretion and excretion are below the normal. It is necessary to prevent, and replace as far as may be, this increased wasting, and at the same time to increase the power of the bactericidal and antitoxic elements, and also to encourage excretion in every possible way. Rest in bed is the first essential during the whole period of fever, and for such time after as the condition of the patient may demand. From very early times it has been recognised clinically that rest is a necessity in the treatment of the acute fevers, and it is interesting to note that the researches of Almroth Wright have confirmed this practice. Wright has pointed out that it is possible in certain chronic infective processes to produce by movement and exercise a toxæmia which is beyond the immediate capacity of the patient's resisting powers. This process of "auto-inoculation" may be used for curative purposes under certain conditions, but the realisation of the meaning of the process will make it very evident that the production of an "auto-inoculation"

by movement and restlessness on the part of a patient acutely ill with a fever, whose powers of immunisation are already taxed beyond their capacity for immediate response, must be followed by evil results and may adversely influence the progress of the disease. Wright's work has added another reason for the absolute quiet of a febrile patient, for the necessity of procuring sleep for him, and subduing his delirium and restlessness.

Attention must be paid to the functions of the gastro-intestinal tract, liver and kidneys, and it must not be forgotten that the skin is a most important organ of elimination. The comfort of the patient must be carefully looked after—much depends on the withdrawal of all powerful sensory stimuli during a fever—quiet and freedom from emotional disturbance is essential, and serious effort must be made to procure sleep. The effect of a sense of well-being on the patient is being more and more realised in the treatment of disease, and it is a matter of common knowledge that the removal of an apparently trivial but troublesome symptom may influence favourably the course of a grave illness. The height of the temperature may in itself call for treatment, although it is to be remembered that fever is only a symptom of a generalised diseased condition, and that interference by certain methods with this symptom may be attended by the worst results. It is a good rule never to give antipyretic drugs. In doses sufficient to reduce temperature they are apt to induce collapse, and sometimes death from cardiac failure. Most physicians have had the experience of being called in to see a case of pneumonia or enteric fever which has been treated with antipyretic drugs in a comparatively early stage of the disease, and have found the patient cyanosed and collapsed, with a feeble flickering pulse and every sign of imminent death. The height of the temperature in itself is a matter of small import. It is the effect of the high temperature and the general toxæmia on the cardiac strength and cerebral mechanism of the patient that the physician must observe with care and combat if necessary. Fever, if too high for safety, or continued in high registers for a prolonged period, should be reduced by external applications of tepid, cold or

iced water, either by sponging, packing, applying compresses or bathing. Where such applications fail to give the patient relief it is not probable that any known drug will reduce the temperature without jeopardising the safety of the patient. In one or two instances, apart from malaria, quinine may be of service. The diet should be fluid and bland; milk, prepared and modified, if necessary, in various ways, should be the chief article of food, alternated with clear soups, rich in extractives. The extractives supply a stimulus to gastric secretion similar to the normal psychic stimulation in health. Soluble carbohydrates may be added to the milk in some cases, and certain specially prepared proprietary foods will be found to be of use. Of these special foods many are almost entirely nitrogenous, and are given with the object of directly repairing tissue waste, *e.g.*, somatose and plasmon. Cathcart's experiments have shown that, without a due proportion of carbohydrate admixture, nitrogenous food is quite incapable of preserving or replacing nitrogenous tissue-wasting, and it has always been my principle in the dieting of fevers to supply as much soluble carbohydrate as can be tolerated by the patient, in the belief that by this means an easily combustible material is offered to the body and the proper utilisation of the nitrogenous food in the dietary assured. I cannot see that benefit ensues from the exhibition of gelatine. It is an end-product, and save as a vehicle for sugar and a way of inducing a patient to take milk, can be of little service in nutrition. Tea and coffee well diluted with milk form a very useful adjunct to the dietary of the fevered. Many people who have a distaste for milk in the natural state may be induced to take fairly large quantities when it is sweetened and flavoured with coffee, while the action of caffeine is not to be despised in the treatment of fevers, especially those of long duration. The addition of eggs, raw and cooked, to the food of those suffering from fever will be discussed later. During convalescence, a mixed diet should be gradually resumed, but its hasty resumption is to be avoided, save in moderate cases of typhus and smallpox, as much permanent damage to digestion has often been done by careless and hasty feeding after many of the acute fevers. Water may be given freely.

It encourages elimination, and its deprivation is a source of irritation to a patient whose mouth is parched and dry. It should be given frequently and in small quantities. Regularity in feeding is of great importance, but sleep should not be interfered with for the sake of a feed. Everything taken should be accurately recorded by the attendant and added up at the end of the day. The mouth should be washed out several times a day with a warm alkaline solution and the teeth and gums should be cleaned before feeding with a piece of cotton wool dipped in a mixture of equal parts of glycerine of borax and warm water.

The use of alcohol in the treatment of acute disease has been discussed of late years *ad nauseam*. The truth lies, as is so often the case, between the views of the extremists. If used with discretion and in moderation it is often of the greatest service; used carelessly and in excessive quantities it is often dangerous. It is ridiculous to condemn a drug like alcohol because when given indiscriminately and to excess it may do harm to the sick person, and it is all the more ridiculous if such condemnation is not the result of unfortunate experience in treating the sick, but is due to a fanatical hatred of alcohol from the social point of view. Opium, chloral, cocain, antipyrin and phenacetin have all been used by drug maniacs to satisfy their hedonistic propensities, yet no sane person would condemn the use of these drugs in medical practice because, taken to excess and apart from the necessities of disease, they have been the cause of the final collapse in the career of certain neurotics. On the other hand, there is some excuse for the anti-alcoholic enthusiasts. The routine treatment of fevers by alcohol in doses which now astonish us, was fairly common among physicians of the last generation, and like all routine forms of drug treatment, has rightly fallen under suspicion. There is little doubt, also, that the careless prescribing of alcohol during convalescence has often helped to revive or establish habits of excessive alcoholism. Alcohol, like all other drugs, must be used, in acute disease, only to tide over certain emergencies, and so used, will be found effective in doses which, compared with the daily allowance of ℥x. and ℥xx., which used to be

common in the treatment of typhus, are positively liliputian. Apart from its use as a diffusible stimulant, alcohol is of the greatest service as a hypnotic and sedative in many of the acute fevers, and it will rarely be found necessary to give more than ℥ii. to ℥iv. in the day, and that only for very limited periods. A drug which can with safety and in moderate doses bring rest and sleep to a child with whooping-cough or to a patient with pneumonia, or quiet the delirium of typhus, cannot be thrown aside to satisfy the prejudices of a few who judge it only by its effects on society when taken to excess and apart from medical necessity.

To save re-iteration, I think it best to give in this introductory chapter certain details in the management of the patient which are common to all the infectious fevers, and to mention under the heading of "home prophylaxis" at the end of the description of each disease those particular points which are specially necessary for the disease under consideration.

If a patient is nursed at home strict isolation from all except his immediate attendants must be maintained. The sick-room should be as large as possible, stripped of all hangings and pictures, and kept well ventilated, but I do not think that the stripping of the carpet is necessary or even wise, if it be brushed damp each day, because it acts to a certain extent as a prevention against the entrance of germs into the spaces between the planks of the floor, and can be easily disinfected at the end of the illness. A polished parquet floor is, of course, the ideal for a sickroom, but this is not often obtainable in Great Britain. The hanging of carbolised sheets over the door is of no service in isolation, and the smell of carbolic acid is very distasteful to many people. Similarly, spraying or vaporising a room with some carbolic preparation is equally useless and unpleasant. "Sanitas Fluid" or some such aromatic disinfectant in the form of a spray is useful as a deodorant. All vessels which have been in contact with the patient or, indeed, have been in the patient's room, should be cleansed with boiling water immediately after use. The water must not only be hot but actually boiling. Sheets and body clothing should all be steeped in a disinfectant solution and boiled before washing, and sponges should be boiled

frequently. Brushes may be effectively cleaned by thorough washing in a strong hot solution of carbonate of soda. It is well for the patient's attendant to have the arms bare to the elbow; no long sleeves or cuffs should be worn by a fever-nurse while on duty. She should wear, while in the sick-room, an overall which should be changed every two days and steeped in 1-20 carbolic solution and boiled before being sent to be washed. Where possible, the attendant should never eat in the sick room, and should always wash the hands and brush the nails thoroughly before a meal. She should eat every four hours; the food should be light and easily digested; the meal should be eaten leisurely; and no one ought to be in charge of a fever patient who is anæmic, who suffers from dyspepsia, or whose teeth are not well kept and free from caries. All attendants on fever-cases should have two hours daily in which to take the air, and the time on duty should not be longer than twelve hours, inclusive of the time spent at meals, 30 minutes at least being allowed for each meal. Of course, the exigencies of particular cases must modify this. One has no sympathy with either the physician or the nurse who are so bound down by rule as to insist on regular routine at times of danger to the patient, and it is to be remembered that, in the nursing of infectious cases in private houses, the care of the room and of the fire and the preparation of simple food should be cheerfully undertaken by the nurse if she is to be of real service to the physician and the patient. The position of the nurse in a private house is often difficult and sometimes unpleasant, but the physician has daily to experience similar discomforts at the hands of ignorant and arrogant people, and if a woman is not possessed of sufficient tact and resource to tide over such difficulties satisfactorily, she should adopt any other profession than that of nursing. In nursing, as in every other calling, people who are continually insisting on their "rights" have a singularly unpleasant time, while those who quietly and without fuss establish their position in each new situation in which they find themselves, are surprised how pleasant work may be. A change of environment necessitates a modification of conduct, and the fittest survive.

FEVERS OF KNOWN BACTERIOLOGY.

Chapter II.

ENTERIC FEVER.

Synonyms. — Typhoid fever: Gastric fever: Pythogenic fever.

French: Fièvre typhoïde.

German: Typhus Abdominalis; Abdominaltyphus.

Definition.—An acute exanthematous fever, characterised usually by a slow and insidious onset, having a duration of some three to five weeks, and associated with a general blood-infection and an invasion of the lymphoid tissue of the ileum causing infiltration and ulceration of Peyer's patches and the solitary follicles, by a specific organism, the B. typhosus, discovered by Eberth in 1880.

Incubation Period.—This is extremely variable, from 2 to 21 days, the usual period being from 10 to 15 days.

Rash.—The rash of enteric fever is very typical. About the 6th to the 10th day of the disease, small "rose-spots" appear on the skin, the abdomen being the most usual situation. They are slightly raised above the surface of the skin, and when firmly pressed upon disappear for a moment. The duration of each spot is three or four days, but they tend to appear in successive "crops," so that the eruption may be visible for weeks. In most cases the spots have all faded some 10 days after the first has appeared. As a rule the eruption is scanty, limited to a few spots on the abdomen, but in some cases the whole abdomen and the lower part of the chest may be thickly covered with typical rose-spots, while in other cases the skin of the body generally may present a very abundant rash. The

rash is present in a large proportion of all cases of enteric fever, but cases do occur in which no rash is visible, and an eruption of rose-spots, quite indistinguishable from a true enteric fever rash, is sometimes met with in cases of abdominal tuberculosis and acute or subacute gastro-intestinal catarrh, so that a typical eruption of rose-spots, although it may strongly suggest enteric fever, is by no means pathognomonic.

A *tâche bleuâtre* having the appearance of faint violet finger-tip marks has been frequently observed as a prodromal rash, or appearing in conjunction with the ordinary rash, but as it occurs in many conditions other than enteric fever it is of no diagnostic value.

Clinical types.—*Period of Invasion*: It is, in most instances, a matter of extreme difficulty to fix accurately the beginning of the period of invasion in enteric fever. The onset of the disease is commonly so insidious and the symptoms so slight at the commencement, that it takes the patient several days to discover that his health is much below normal. He usually becomes gradually aware that his appetite is poor and his tongue furred; he has a "bad taste in the mouth," while he suffers from a feeling of slight general malaise and listlessness; he may have some headache and find that his powers for work are below normal. In other words, he feels unaccountably "run down," and at this stage of his illness, if he be a person of sedentary occupation, he frequently takes more exercise than usual in the hope of bracing himself up. In spite of this, however, he finds that the feeling of lassitude grows, and he is conscious of a real increasing enfeeblement, which at last makes him take to bed, while headache, which may have been only slight and transitory at first, very frequently becomes an urgent symptom. At the same time he may suffer from deafness, and his friends notice that he is a curious compound of listlessness and irritability. Sore throat, with congestion of the fauces and tonsils, is a frequent symptom. The period of invasion lasts usually for about a week, sometimes more and rarely less, and it is in this period that a patient may do himself unconscious harm by endeavouring to "work off" what

appears to him to be a slight temporary ailment. In a small proportion of cases the period of invasion is short and the symptoms urgent. The patient may be suddenly seized to all appearance with an acute pneumonia, and only the subsequent course of the illness will shew that the pneumonia has been due to an invasion of the B. typhosus. In certain of the cases with sudden onset the disease may simulate an attack of scarlet fever, with high temperature from the onset, inflamed fauces and tonsils and a bright scarlatiniform rash, and it is only when the rash fades without abatement of the fever and the characteristic "rose-spots," which in such cases are usually very profuse, appear, that enteric fever is even suspected. In other cases a rapid and severe onset is not attended by any such manifestations as to make the attack likely to be confused with any other of the acute eruptive fevers, and it is in such cases that a hasty diagnosis of "influenza" is often made.

In those cases with a scarlatiniform prodromal rash the pulse-rate is a help in the differential diagnosis, since even in such cases the comparatively slow pulse, so generally met with in the early stages of enteric fever, is the rule. In a few cases the period of invasion is characterised, perhaps after a day or two of indefinite malaise, by violent symptoms of a cerebral kind. The patient may be wildly delirious, or completely unconscious; he may complain of severe headache, may suffer from vomiting of a cerebral type, have an irregular pulse, and exhibit a typical "tâche cérébrale," and such cases are often reasonably mistaken for meningitis.

The bowels during the period of invasion are frequently constipated, more rarely loose. It is very common during this stage of the disease to find a little diffuse bronchial catarrh, which may lead the practitioner astray, especially as fever may be moderate, and even, save in the evening, absent.

As a rule, the physician is called to see the patient just as the period of invasion is over and the *fastigium* is reached. In the typical or classical case the patient lies on the back, disinclined to move, his whole attitude being one of profound exhaustion. The face generally is pale, with some flushing in the malar regions. The eyes are clear and the pupil is

most usually dilated. The tongue is coated at the back and centre with a white creamy fur and the patient is conscious of a disagreeable taste in the mouth and has lost all appetite. The pulse is moderate in rate, between 80 and 90 per minute, although the temperature may be ranging between 101° and 103° F. Respirations are quiet in the absence of any pulmonary implications, or where there is only the slight catarrh of the larger bronchi that is so commonly met with. Headache may be a troublesome symptom and may interfere with sleep. Deafness is more often present than not, and although usually slight, may be almost complete. So frequently is deafness a symptom in the early stages of the disease that an unexplained rise of temperature continuing over some days and associated with deafness, should always, in the absence of any gross lesion of the middle ear, suggest to the mind of the physician that the illness is enteric fever. The spleen is usually appreciably enlarged after the eighth day. The abdomen is often slightly distended, more particularly in the right iliac region, and manipulation in this region may give rise to a feeling of discomfort on the part of the patient, and the physician may be aware of some gurgling under his hand. Examination of the abdomen should always be made with the greatest care, as rough handling may precipitate the occurrence of hæmorrhage or a general peritonitis. The fastigium is said by older writers to last for a week, but it is seldom that its duration is so short, save in the mildest cases. In cases even of moderate severity it is usually prolonged to 10 days or a fortnight, and it is characterised by an increase in the symptoms described above. The patient's feebleness is striking; even slight movement is an effort, and he needs constant attention from the nurse. The fur on the tongue becomes brown and sordes is apt to collect on the teeth. Emaciation is marked. As the third week of the disease is entered upon, there is a tendency for congestion to appear at the bases of the lungs, the pulse grows rapid and very soft, while delirium, sometimes low and muttering, sometimes loud and violent, may be present. The intestines may be distended with flatus, and colicky pains are sometimes very troublesome. A little vague pain apart from

colic is sometimes felt in the right iliac fossa, but this is rarely more than a slight uneasiness. Throughout the fastigium the temperature remains fairly high, between 101° and 103° F. as a rule, with sometimes a rise to 104° F., and the daily variation is rarely more than 2° F., so that the fever is at this stage of the "continued" type. Diarrhœa may be troublesome, four or five motions in the day being not uncommon, and sometimes the patient is troubled with very frequent small evacuations. But constipation is quite as common, necessitating the moving of the bowels by artificial means, either by drugs or enemata.

In a simple uncomplicated case, even of fair severity, one may reasonably expect an abatement of the disease at some time in the third week, or after the fastigium has been maintained for some 8 or 10 days. The morning remissions of temperature become greater, although in the early stages of the *period of declension* the evening temperature may be maintained at its former high level. Gradually the morning remissions fall to a lower level, the evening exacerbations fail to reach the height of the previous day, and the fever declines by a gradual lysis, which may proceed for a week or a fortnight before the evening temperature remains normal. Rarely the fever terminates by crisis, slightly less rarely by a rapid lysis occupying only two or three days. Occasionally at the beginning or during the course of the lysis, the temperature may shew very large daily excursions. It may rise suddenly, sometimes associated with rigor, to very high registers, even 105° or 106° F., and may fall, with signs of collapse on the part of the patient, to normal or subnormal levels in a few hours. This "swinging" temperature may continue, in varying degree, for some days, and, although it is not in itself a particularly ominous sign, shewing as it does that the patient is capable of powerful reaction, it may cause alarm to the patient's friends and to those among his attendants who are not familiar with the conditions. It usually occurs in a severe attack of enteric fever, and is, I think, indicative of the sudden separation of extensive sloughs in the intestine. With the declension of the fever, the patient becomes less dazed and delirious, the tongue becomes cleaner and there is

an increasing tendency to sleep. The pulse grows less rapid, and begins to recover its tone. If bronchial catarrh or pulmonary congestion has been present it tends to disappear, while the patient may regain his appetite to a considerable extent, even before the temperature has reached normal. Distension of the abdomen passes away, and, when diarrhœa has been a feature in the case, the stools become less frequent. When constipation has been present, however, there is usually no corresponding relaxation of the bowels, which may require to be moved artificially well into the period of convalescence. The stools in a case of enteric fever which is not constipated are often very typical, being loose and yellow in colour during the first fortnight, so that they have been likened to pea soup. Their odour is usually rather offensive. During the third week of the disease their appearance alters and they become greenish in colour and may contain sloughs.

After the temperature has remained normal for about a week, one may say in most cases that convalescence is established and that the further progress of the case will be uneventful, although relapses have been known to occur long after that period.

Such is the course of the moderately severe and uncomplicated case of enteric fever, but the type of the disease varies very much in different epidemics, so that in some years this moderate type forms the vast majority of the cases met with, while in others a much more severe type occurs with great frequency.

A *more severe type* is that in which the fastigium is ushered in by high fever with marked nervous symptoms, much diarrhœa, and an early tendency to pulmonary congestion. In such cases the abdomen is frequently enormously distended with flatus and the patient may suffer much from colic. The early delirium and restlessness combined with great cardiac enfeeblement make the patient's recovery a matter of doubt from a very early stage, apart from the occurrence of any complication. In many of these cases death occurs from sheer toxæmia late in the second or early in the third week, with very high temperature and rapidly failing heart. In such cases the face and even the skin

generally are dusky and livid, and the extremities are frequently very cold. Where recovery does take place, it is only after a prolonged fever, slow declension, and very tedious convalescence.

On the other hand certain cases of enteric fever present a type of the disease *so mild* that it is difficult of recognition. It is sometimes so slight that the patient may be conscious only of a little general malaise and may never take to bed or consult a physician. Such cases are described as "*ambulatory*," and are extremely dangerous to the community from their capacity for widely spreading infection. Attacks of "ambulatory" enteric fever are not without their danger to the patient, since, in spite of their mildness, they may be attended by one or other of the more dangerous complications of the disease, and a hæmorrhage from the bowel, a perforation of the intestine, or a severe venous thrombosis may make it plain that the patient is the subject of a grave disorder, although his symptoms up to the time of such an occurrence may have been of the most trifling description. In other cases the disease, although very mild in type, is sufficiently marked to make the patient take to bed. He may have no nervous symptoms, no pulmonary congestion or bronchial catarrh; his sleep may not be interfered with; his bowels may be normal in their action, and save for a slight daily fever and sense of weakness, no symptom may present itself that is apparently worthy of serious attention. Even in such mild cases, however, the spleen may be perceptibly enlarged during the second week, and an eruption of rose-spots may be present. It is of the greatest importance to the patient who suffers from a mild attack that his physician should be fully alive to the gravity of the condition, because, as in the "ambulatory" type of the disease, complications may arise that may threaten life, and any laxity in treatment may readily encourage their occurrence.

Complications.—The more common complications to be met with in enteric fever are:—

1. Perforation of one of the ulcers in the ileum.
2. Rupture of a suppurating mesenteric gland.

3. General peritonitis without an apparent local focus.

4. Hæmorrhage from the bowel.

5. Venous thrombosis.

6. Arterial thrombosis and the formation of abscesses in the subcutaneous or inter-muscular connective tissue.

7. Lymphangitis.

1. *Perforation of the Intestine.*—This is, perhaps, the gravest of all the complications. While its occurrence is easily recognised when the symptoms are typical, it is often difficult of recognition on account of the masking of the symptoms by the general condition of the patient. The symptoms usually described as typical of the occurrence of perforation are severe pain in the right iliac region, accompanied by a feeling of great distress on the part of the patient and the general facies of collapse. Vomiting may be present. The temperature falls and the pulse-rate rises. The rise in the pulse-rate may be followed in an hour by a fall to its primary level, but thereafter it gradually rises again. The abdomen is distended; there is an encroachment on the hepatic dullness and possibly on the splenic dullness. Respiration is thoracic in type and increased in rate. The patient's expression is anxious and "pinched," and his strength is rapidly reduced, so that speech is faint and difficult. The abdomen is rigid, either generally or only on the right side. Sweating is not usually a marked symptom in the early stages of perforation, though it may occur in association with a wide-spread general peritonitis. It is true that if all these signs and symptoms are present, no one can help making a diagnosis of perforation, but, unfortunately, it is not the rule that all such signs and symptoms appear early after the occurrence of perforation, and, if they are present early, it augurs badly for the success of the one form of treatment which offers any hope to the patient, operative interference. A certain amount of pain is usually present, but it may not be severe and stabbing in character, and may not be associated with the typical facies of collapse. The temperature may fall, but for about an hour after perforation has occurred it may remain

stationary or even rise. After that time, however, it falls, to some extent at least. The type of respiration may or may not be altered. The patient's expression, however, is always anxious and slightly "pinched," suggestive of some occurrence out of the ordinary, and as a general rule the pulse-rate is distinctly raised. The occurrence of abdominal pain, accompanied by rise in pulse-rate and some rigidity, either general or limited, of the abdominal wall, and a new anxious look on the patient's face, are the signs which should make the physician at least suspect the occurrence of perforation, and take immediate steps accordingly. To wait until the diagnosis is completed by the occurrence of abdominal distension and encroachment on or disappearance of the liver-dullness is, in view of modern surgical technique, criminal. In many cases the abdomen may be rather sunken for a little time after the occurrence of perforation, and by the time that it has become distended all hope of successful interference may be gone.

In certain cases the gut may be so distended as to displace the heart and cause disappearance or diminution of the præcordial area of dullness, and similarly the hepatic area of dullness may be greatly lessened, without the occurrence of perforation. The sudden onset of a pleurisy or a hæmorrhagic infarction in the lower part of the right lung may give rise, by referred pain, to a simulation of an attack of perforation. I have known one patient operated on after such an occurrence, and it was only on post-mortem examination that the existence of a large hæmorrhagic infarction in the lower lobe of the right lung was discovered. Sometimes before the occurrence of a perforation of the intestine the patient may complain for some hours of considerable pain in the right iliac fossa without other symptoms. This has been called "pre-perforative" pain. Occasionally, one or two loose motions, streaked with blood, in a case not previously afflicted with diarrhœa, may immediately precede a perforation.

2. *Rupture of a suppurating gland* presents symptoms practically identical with those of perforation of the intestine, but on the occurrence of rupture the temperature rises at once.

3. *General peritonitis without perforation of the intestine or rupture of a gland.*—This condition is comparatively rare, but Macrae of Glasgow has met with it in ten out of sixty-six cases of general peritonitis in enteric fever on which he has operated. The symptoms are those ordinarily met with in general peritonitis from any cause, and it is only on operation, sometimes followed by more detailed observation *post-mortem*, that the true nature of the condition has been discovered. In such cases the most careful search fails to reveal any local focus, and one can only come to the conclusion that the peritonitis is due to the general blood infection either directly or through the medium of several tiny venous or arterial thromboses such as are met with elsewhere.

4. *Hæmorrhage from the bowel* is a complication which is met with frequently, and its severity is very variable. The amount of blood lost may amount only to a few drachms, or it may resemble a post-partum hæmorrhage and be so profuse as to soak the mattress. Like all complications of enteric fever it usually occurs in the third or fourth week of the disease, or, to put it in another way, at some time after the process of ulceration has begun. But hæmorrhage is not always associated with deep ulceration of the intestine. The most copious hæmorrhage which I ever saw in enteric fever occurred in the old Fever Hospital in Paisley, and was so profuse that within an hour the mattress was soaked through and blood dripped on the floor. *Post-mortem* examination revealed no deep ulceration of Peyer's patches, but only an enormous number of the fine hæmorrhagic points situated in the last two feet of ileum and associated with an extraordinary congestion of the whole mucous membrane. The patient was a woman who had had ordinary menstrual periods and whose family showed no trace of the hæmorrhagic diathesis. Apart from these rare cases of intestinal flooding, the amount of blood lost during the attack has little value as regards prognosis. In some of the most rapidly fatal cases which I have seen, the amount of blood lost has been trifling, although the hæmorrhage has been repeated many times. I speak now only of those cases where the amount of blood lost has been small and where no large amount of clot has been found in the

bowel post-mortem. It is necessary to be thus explicit, as in many cases where the loss of blood has been apparently trifling, *post-mortem* examination has revealed the existence of a large concealed hæmorrhage. It is of the greatest importance for the practitioner to realise the significance of hæmorrhage as regards prognosis, and one should always give a guarded prognosis when hæmorrhage has occurred, however slight the amount may be, since the passage of a merely blood streaked stool may be followed by the occurrence of a fairly copious flow of bright blood, the passage of a stool consisting almost entirely of clots, or a large stool of fæcal material intimately mixed with dark altered blood. The prognosis must always be given after consideration not only of the amount of the hæmorrhage but of the other signs and symptoms which the patient may present. My own experience has always led me to give a very grave prognosis when hæmorrhage occurs, even though slight, with a rising temperature and pulse-rate, which is not disturbed by the occurrence of the bleeding. On the other hand, a slight hæmorrhage, occurring towards the period of declension, not accompanied by any very grave signs of general disturbance, may augur nothing of danger if accompanied by a sudden and well marked fall in temperature, and I have known cases which have terminated favourably by a crisis which followed on the occurrence of a large hæmorrhage. Hæmorrhage in a patient who shows marked signs of toxæmia is always a grave symptom, because in such profoundly poisoned cases it is often repeated, and is dangerous, like frequent diarrhœa, if only on account of the extra movement of the patient which it involves, while it indicates a condition of great gravity in the same way as does the hæmorrhagic type of other acute fevers. It is common to publish charts which show a considerable fall in temperature at the occurrence of a hæmorrhage, but while this does frequently occur, sometimes with all the symptoms of profound collapse, lividity and coldness of the skin, accompanied by profuse cold sweating, a hæmorrhage may occur without the slightest disturbance of the temperature curve. Most commonly no general symptoms give warning of the attack, but in some

cases the patient may suddenly collapse, complain of a vague abdominal discomfort, and have a general sense of uneasiness; he may grow livid and cold, the temperature may fall, the pulse-rate rise and beads of cold perspiration stand out on his face, and it may not be till upwards of an hour afterwards that occurrence of an intestinal hæmorrhage may explain the general disturbance. Such cases may for a moment suggest perforation, but the absence of pain and of the pinched "abdominal" facies will guide in the formation of a diagnosis, and in any case the hæmorrhage will have declared itself before any surgical interference can be made. Profuse cold sweating is always a grave symptom in association with hæmorrhage.

5. *Venous thrombosis* is often a troublesome complication, and, as in puerperal septicæmia, one or other femoral vein is its commonest situation. It occurs also in the saphenous and popliteal veins and has been observed, very rarely, in the axillary and sub-clavian veins. Such thrombosis is usually one-sided. It occurs late in the disease, and may, indeed, appear only during the period of convalescence.

6. *Arterial thrombosis and abscess-formation in the subcutaneous or intermuscular connective tissue.*—Thrombosis of any of the larger arteries is a comparatively rare condition, but it has been observed as giving rise to gangrene of the toes, the whole foot, and even of the leg to above the knee, the arteries usually involved being the femoral, popliteal or posterior tibial. The middle cerebral artery has also been described as being the seat of thrombosis, giving rise to apoplectiform and convulsive attacks. Such thrombosis occurs usually in the third, fourth or fifth weeks of the disease.

But it seems likely that thrombosis of small arterial twigs is fairly common. It is difficult to explain otherwise the occurrence of those subcutaneous and intermuscular abscesses that are so frequently met with late in the disease. The thigh, leg, lumbar region and buttocks are the commonest sites for such abscesses, but they may occur anywhere.

7. *Lymphangitis.*—As in puerperal infections, a lymphangitis of the thigh is a fairly common complication of enteric fever, and it is very likely that many cases of swelling and pain in the thigh have been labelled as venous thrombosis which were really lymphangitis. Many believe that lymphangitis is much more common in enteric fever than venous thrombosis, and there is much evidence in support of their view. The diffuse tenderness and the uniformly pale colour of the swelling, are points in favour of the diagnosis of lymphangitis.

Other complications occur in enteric fever, all about the third or fourth week in the disease, that are sufficiently uncommon to merit only a word in passing. *Cystitis* and *pyelitis* may occur from infection of the urinary tract by the B. typhosus. The prognosis in both these conditions is generally favourable, since we are dealing with an infection upon which Nature has put a more or less definite limit. Some *blood* may be present in the urine in association with the pyelitis, but an acute nephritis is seldom seen, although albuminuria of a "febrile" and transitory kind is frequently present. *Pleurisy* is met with fairly often, sometimes accompanied by sero-sanguinolent fluid effusion, and occasionally resulting in *empyema*, which may or may not be due to the B. typhosus. A somewhat rare but alarming complication is *hæmorrhagic infarction of the lung*, due probably to thrombosis occurring in the right heart with subsequent embolism, or to the formation of a large thrombus in the pulmonary artery. It may also be due to an embolus carried from a thrombosed vein in the leg or elsewhere. The infarction is accompanied by more or less sero-sanguinolent effusion into the pleural sac, and has been known to result in an empyema. The signs of the infarction are sudden pain in the chest or referred to the abdomen, limitation of thoracic breathing, some dullness on percussion over the affected area, with diminution in the volume of the respiratory murmur, and, very soon after the occurrence, the auscultatory signs of pleurisy and some fine intrapulmonary crepitus with distantly tubular breath-sounds are evident. Sooner or later after the occurrence of the

infarction, the sputum is tinged with blood, sometimes in considerable quantity, but I have been struck, in the four cases which I have seen, by the small quantity of blood present and the delay in its appearance. In one case no blood appeared in the sputum until some five days had elapsed after the infarction had occurred. Of the four cases under my own observation two died, one having been operated on in mistake for perforation of the intestine, the other after the occurrence of an empyema from which pure cultures of the B. typhosus were obtained. The other two cases made a good recovery.

Peripheral Neuritis is sometimes met with, usually indicated only by persistent pain in the heels or toes which may last until the patient has completely recovered in other respects. The "tender toes of typhoid" are familiar and troublesome results of the fever and appear late in the period of declension or during convalescence. Peripheral neuritis of a more serious kind is occasionally met with, resulting in "dropped wrist" or "dropped ankle," and once, in the case of a medical man, I have seen a double ulnar palsy which persisted for months.

Endocarditis is a very rare complication, but it does sometimes occur and may be followed by infarction of the kidney or spleen.

Sequelæ.—The sequelæ of enteric fever are such as might be expected from a long febrile illness associated with a special lesion of the intestine. It is common for the patient to complain for many months after his illness, of *distension of the abdomen* and *flatulence*, associated with some pain in the right iliac region. Combined with or apart from this he often gives evidence of marked *neurasthenia* long after convalescence has been thoroughly established. He is physically weak, and easily tired mentally. He shirks his work, avoids meeting people, is afraid of various things, and may show a tendency to melancholia.

In a few cases which I have seen, this neurasthenic condition combined with considerable abdominal discomfort has led the patient to resort to alcohol and drugs to relieve his depression, with the result that a previously temperate man has

become a confirmed alcoholic or drug-maniac. Post-enteric neurasthenia is confined to no particular age or sex. Children, adolescents, and adults of all ages, male or female, may fall a victim to this extremely troublesome disorder.

Typhoid Spine.— This condition is comparatively uncommon, and was described by Gibney in 1889 as a painful affection of the spine with exaggerated knee-reflexes, appearing towards the end of an attack of enteric fever or during convalescence.

Pain is the most prominent symptom, and is felt in the lower dorsal and lumbar region, extending, in some cases, round the body and down the legs. It is often associated with tenderness over one or two vertebral spines, and some swelling of the adjacent soft tissues is not uncommon. In one case, reported by Ogilvy in the Journal of the American Medical Association, vol. li, p. 406, the swelling and tenderness extended on both sides of the spine over practically the whole of the dorsal region. Areas of hyperæsthesia are frequently met with on one or other side of the tender spot.

Kyphosis and scoliosis have both been observed in connection with this condition.

Walking is difficult and increases the pain. Paresis of the legs is sometimes met with, and the patient may suffer from spasm and cramp and even wasting of the leg muscles.

The spine is sometimes fixed and rigid, and in some cases the slightest movement of the patient, and even of his bed, will induce a severe attack of pain in the back.

Slight fever is frequently present when the condition makes its appearance during convalescence.

The patient who suffers from typhoid spine is often the subject of a general neurosis, and may be hysterical, imaginative, and uncontrolled in many ways, even though his previous history has not shown any indication of a neurasthenic habit. In some cases, of course, the patients have always been neurotic and fanciful.

The onset of the condition is usually during convalescence, being seldom delayed longer than three months after the attack of enteric fever has subsided, and most commonly

appearing just as the patient begins to move about. The duration varies from a week or two to many months, but recovery is practically invariable.

The cause of typhoid spine is probably not always the same.

In certain cases described by Osler it would appear to be the result of a neurosis, and in such cases the temperature and pulse are not abnormal, and paraplegia of a definitely hysterical type may be present; fleeting disturbances of sensation, and pain in the back, without any indication of gross spinal lesion or disease of the vertebral column, are observed, while signs of a general neurotic or neurasthenic state may be apparent.

In another group of cases there is definite evidence of perispondylitis and spondylitis, evidenced by kyphosis or scoliosis, tenderness and pain over one or more vertebræ, and swelling of the soft parts in their neighbourhood. In some cases a definite formation of new bone has been observed in connection with the spondylitis.

Typhoid spine, therefore, would appear, from the writings of Gibney, Osler, McCrae and others, to be a name given to a set of symptoms in variable combination, of which the most constant is pain in the back, usually associated with some weakness in the legs, stiffness in the back, and exaggerated knee-reflexes, due either to the post-enteric neurasthenic state or to a definite perispondylitis or spondylitis in the lower dorsal and lumbar regions.

Care must be taken in arriving at a diagnosis of typhoid spine to exclude the even rarer conditions of *focal myelitis* and *spinal meningitis* which may be associated with exaggeration of the knee-reflexes and a plantar reflex of the extensor type, without there being any affection of the sphincters of the bladder and rectum. It must be remembered, also, that an *insular sclerosis* has, in one or two cases, followed on an attack of enteric fever.

Diagnosis.—The diseases most likely, from their general symptomatology and course, to be confounded with enteric fever are *abdominal* and *general tuberculosis*, *tuberculous meningitis*, irregular forms of *malaria*, low forms of *broncho-*

pneumonia, acute pneumonia of the upper lobe, typhus fever, influenza, and *paratyphoid fever.* It is only during the first week or ten days that acute lobar pneumonia with concealed physical signs is likely to give rise to a suspicion of enteric fever, and then the mistake in diagnosis is usually made more from insufficient examination of the chest than from any real simulation of enteric fever by the pneumonia. The differential diagnosis between typhus and enteric is often difficult during the first ten days of acute illness, but as a rule the types of the disease are distinct and separate, the flushed dusky face with blood-shot eyes of the typhus patient contrasting strongly with the pale face, malar flush and clear eye of enteric fever. But in enteric fever the face may be sometimes flushed and dusky at an early stage, the delirium may simulate that of typhus, the eye may be bloodshot and suffused rather than clear, and the differential diagnosis may depend on one or other of the special methods available for the diagnosis of enteric fever.

Careful examination of the blood will usually exclude malaria, as it is rare to have a case of ague, however aberrant the type may be, in which the infecting organism cannot be discovered by those to whom the technique of examination is familiar.

For the differentiation of enteric fever from tuberculous affections one depends clinically on the development and the course of the disease, on the occurrence of definite special symptoms and the application of certain tests. The occurrence of squint or other evidence of palsy of the external muscles of the eye, double vision, or failing sight will often make it clear that a doubtful case has been a somewhat obscure example of tuberculous meningitis. Enlargement of the abdomen with, perhaps, signs of fluid or a "doughy" feeling on manipulation or with definite distension of the abdominal veins, will indicate a tuberculous peritonitis, and the discovery of tubercle bacilli in the sputum will lead to the diagnosis of pulmonary phthisis, especially if the patient has not been in very good health before the onset of the symptoms which have led to his coming under observation. Of course,

it is possible that a patient suffering from phthisis may contract enteric fever, and it is therefore wise to make special examination of the blood for signs of enteric fever in all cases where the diagnosis is doubtful, and, where there seems to be a possibility of some tuberculous mischief being present, to perform Calmette's or von Pirquet's tests, or give a test injection of tuberculin.

Paratyphoid fever is practically similar in its manifestations to a mild attack of enteric fever, and a purely clinical differentiation is impossible. Its diagnosis must depend on the absence of an agglutinative reaction with the B. typhosus and the presence of an agglutinative reaction with the B. paratyphosus, or on the recovery of the B. paratyphosus from the blood. The methods of cultivating the B. paratyphosus are similar to those employed in the cultivation of the B. typhosus, and the differences in the two organisms are brought out by subculture on various media, as will afterwards be described. The bacilli can also be tested with serum which is known to have the power of agglutinating the B. typhosus.

The blood in enteric fever shows as a rule a fall in the number of white cells to below the normal. On the occurrence of perforation or general peritonitis from any cause a polymorphonuclear leukocytosis often occurs, but not invariably, while a leukocytosis may occur in connection with a pleurisy with effusion, an empyema, or any suppurative condition.

The *special diagnostic methods* of greatest service in the diagnosis of enteric fever are the bacteriological examination of the blood and Widal's agglutination test. *Widal's reaction* depends on the power of the blood-serum of a patient suffering from enteric fever to agglutinate living motile cultures of the B. typhosus in large dilution and in a short time. The degree of dilution of the serum is important, as in certain other diseases the serum from the patient will agglutinate cultures of the B. typhosus if the dilution is small and the serum be left in contact with the bacilli for a long time. It is my practice to perform the test with blood-serum diluted 60-100 times with an emulsion of a young culture of B. typhosus in sterile salt solution, and if satisfactory clumping does not take place within forty-five minutes

to an hour, to consider the reaction negative. With these precautions the test is often of the greatest service, but it is to be remembered that an agglutinative reaction is seldom obtained earlier than the eighth or tenth day and may not appear until convalescence is well established, so that a negative result cannot of itself exclude enteric fever. As a rule, however, the reaction can be obtained after the first eight or ten days of the disease. Other diseases in which Widal's reaction may be obtained are general tuberculosis and typhus, and occasionally the reaction is present in these diseases even after the serum has been well diluted. It is unfortunate that these are two of the very diseases which are frequently difficult to distinguish from enteric fever.

Of far greater value in the early diagnosis of enteric fever is the making of a *culture from the blood*. 10-20 c.c. of blood is drawn from a vein with proper aseptic precautions, citrated, placed in peptone bouillon after long centrifugalisation in sterile tubes, and incubated at 37° C., and the resulting growth examined for the B. typhosus.

If an organism is present which has the morphological characters of the B. typhosus, subcultures must be made on differentiating media to make sure that it is the B. typhosus and not the B. paratyphosus. Media containing glucose or dulcite coloured with neutral red, and milk containing litmus are of most service. The B. typhosus forms acid without gas with glucose; the B. paratyphosus forms both acid and gas. With dulcite, the B. typhosus forms neither acid nor gas; the B. paratyphosus forms both. After three days' incubation at 37° C. in litmus milk, the B. typhosus shows the production of acidity, and the B. paratyphosus the development of alkalinity.

The results are conveniently shown in the form of a table:—

	Glucose.	Dulcite.	Litmus Milk. 3 days.
B. Typhosus	Acid.	—	Acidity.
B. Paratyphosus	Acid & Gas.	Acid & Gas.	Alkalinity.

This differentiation can be done by any one who has had a good bacteriological training and possesses an incubator, but both the blood culture and Widal's test are better done by a bacteriologist in connection with the Public Health administration of the district or one of the large Clinical Laboratories. In many places such examinations are made by the municipal bacteriologist.

The *diazo-reaction* of Ehrlich is of little value in the differential diagnosis, and is but rarely used now.

Puncture of the spleen for the recovery of the B. typhosus has been done occasionally, but this procedure is not to be recommended, as the typhoid spleen is soft and the resulting hæmorrhage may be severe, and even fatal. The operation, too, is painful and may induce shock.

Relapses are very common in enteric fever.

The temperature may run a typical course, with a fastigium of average or more than average length, and a lysis of considerable duration, yet after it has remained normal for periods varying from one to ten or twelve days it may again rise gradually and the patient embarks on what is practically a second attack of the fever, including the eruption of rose-spots. Relapse may occur after a primary attack of great severity and long duration, and also after an attack which has been very mild indeed. As a general rule a relapse is milder than the primary attack, but to this rule there are many exceptions, and a severe, and even fatal, relapse may follow a primary attack so mild as to be almost "ambulatory" in type. It is unusual to meet with any of the graver complications of enteric fever in the course of a relapse, but they do occur, particularly where the primary attack has been mild and the subsequent relapse severe. Sometimes several relapses follow the primary attack, and the severity of each of these is usually much less than its predecessor. Four relapses is the greatest number which I have seen, but more have been recorded. Each relapse is separated from its successor by at least a few days of normal temperature. The term *recrudescence* is used to describe the condition when the temperature begins to rise again after the lysis has commenced, but where

the curve has not reached normal. The distinction between *relapse* and *recrudescence* is purely arbitrary.

Treatment. — In considering the treatment of enteric fever we must remember that we are dealing with a prolonged febrile disease in which wasting is a prominent feature, in which the fever often runs high, which may be attended with profound toxæmia, and which may show various complications that call for special treatment.

In no acute fever, save, perhaps, pneumonia and diphtheria, is the necessity for absolute physical and mental rest so urgent as in enteric fever, not only from the necessity for husbanding in every way the patient's strength, but also because movement may prejudice the local lesion in the intestine and encourage hæmorrhage or perforation. It is the custom in this country to insist on the use of the bed-pan and bed-urinal, although in mild constipated cases it may be no disadvantage to allow the patient to get up to stool if the night-chair is placed close to the bed and he is not allowed to walk.

If constipation is present, the bowels should be moved at least every second day by soap and water enemata, unless the calomel treatment is adopted, and flatulent distension may be greatly relieved by an injection of olive oil and turpentine. Where flatulent distension is troublesome, the application of tepid compresses to the abdomen every four hours or oftener, for fifteen minutes at a time, may give great relief. Frequent and troublesome diarrhœa is often controlled by the introduction of a long colon-tube and gentle but free irrigation of the lower bowel with warm water.

The patient should be washed all over daily with soap and water. The skin of the back, especially over the buttocks and sacrum, should be sponged several times in the day with methylated spirit and carefully powdered with a dusting-mixture of equal parts of powdered starch, boric acid and lycopodium, to prevent the occurrence of bed-sores which should never be seen in a carefully tended patient. Great care should be taken to change the position of the patient frequently, both to avoid bed-sores and to prevent as far as possible the development of hypostatic congestion of the lungs.

In profoundly toxic cases the injection of a pint of hot sterile salt solution into the subcutaneous areolar tissue is often productive of good results.

Headache may be relieved by the application to the forehead of cloths dipped in cold water and vinegar. It is best to avoid giving phenacetin as it is rather depressing, but the citrate of caffein is effective in doses of five grains repeated every few hours, and the use of the bromides is often followed by excellent results.

Delirium and restlessness, even apart from excessive fever, are best treated by cold applications to the skin, either by means of sponging, compresses or baths, but it may be necessary to use opium or other hypnotics to quiet the patient and induce sleep. It must be remembered that patients suffering from enteric fever bear opium badly, and that even in moderate doses it tends to induce meteorism. If it is used at all, it should be given in small doses, 5-10 minims of Battley's solution or Nepenthe by the mouth, combined, it may be, with five grains of chloral hydrate or ℥ss of the Syrup of Chloral, or the hypodermic injection of morphine, gr. $\frac{1}{6}$, may be employed. Such doses of opium, alone or in combination, may be repeated every three or four hours until the patient is quiet or until it is evident, after some half-dozen doses, that the treatment is of no avail. Veronal, trional, or sulphonal in doses of ten grains in ℥ss-℥i of whisky with hot water and a little sugar sometimes act very well and induce sleep after two or three doses at intervals of two hours have been given. Occasionally I have seen sleep produced and violent delirium quieted by paraldehyde in doses of 90 minims repeated at intervals of an hour till three doses have been taken. Sometimes ℥i or ℥ii of whisky with hot water and sugar given in the evening will induce sleep in a patient who is just beginning to show signs of restlessness and who has not been relieved by cold or tepid sponging.

It may be necessary to reduce the temperature if it be at all high, say above 103° F., and the patient is restless and uncomfortable. No antipyretic drugs should be used for this purpose, but the temperature can often be reduced by 2° F. or more by cold sponging, by a cold compress applied to the

front of the body from neck to knees and changed every two or three minutes; by rubbing the surface of the body with a block of ice; or by the use of the cold or tepid bath. The bath is excellent for Hospital use, but is almost impracticable in private practice, as a large portable bath, capable of holding an adult patient stretched at full length, is necessary. This inconvenience is the only valid argument against the intelligent use of the bath, which should be kept at a temperature of about 80°-90° F. during the immersion. In careful hands no harm should result from the manipulation of the patient, and fever and restlessness which have not yielded to any other form of treatment may yield to this. But in private practice nearly as good results are obtained from the use of the cold compress applied from neck to knees, changed every minute or two and repeated until a fall of temperature of, say, 2° F. has been produced. If this fails, it is comforting to remember that in certain cases the fever will not yield even to repeated cold baths, but continues to rise, or at least to remain stationary at a very high level, in spite of all the efforts of the physician. When this occurs it is plain that we are dealing with a peculiarly virulent form of the disease, probably a fulminant type that will kill whatever endeavours we may make towards its cure. It is interesting to observe that a great reduction of temperature is not necessary to ensure marked improvement in the patient's condition. The reduction of the temperature by 1° or 2° F. is usually sufficient to produce a feeling of comfort and quiet in the patient and to induce sleep, even if only for a short time. It is not wise by prolonged exposure to cold applications to reduce the temperature to the neighbourhood of normal at the expense of the patient's comfort and strength, as is so often done. To put it broadly, the temperature should be reduced as little as possible, compatible with the comfort of the patient, save when grave hyperpyrexia is present. A fall of 2° F. accompanied with comfort is better than a fall of 4° F. accompanied by a feeling of prostration and faintness on the patient's part. The relief from high fever is only temporary and the cold applications may have to be frequently repeated before the general course of the temperature returns to moderate levels.

The "swinging" type of temperature which is often met with at the period of declension is sometimes attended by rigors while the temperature is rising and collapse when the temperature falls. The patient must be kept warm under these conditions; hot bottles or sand-bags should be placed at the feet and along the sides, and hot cloths applied over the heart. Quinine in doses of 10 grains is said by some to influence this type of fever, but I have never seen any good come of its use.

Strychnine is sometimes of service when there is a tendency to meteorism, and is best given hypodermically in doses of $\frac{1}{60}$th of a grain repeated every four hours. This may be continued for several days at a time. When the pulse is unduly rapid and soft, digitalis should be given, and if given at all the dose should be fairly large. I have obtained the best results with Nativelle's granules of crystalline digitalin, giving one every three or four hours, but 10 minims of a reliable tincture given every two hours until an effect on the heart is produced or nausea and diarrhœa occur is less expensive and practically as rapid in action. It frequently happens, however, that digitalis has no effect in slowing the pulse, and if any signs of digitalis poisoning appear, it is wise to discontinue the use of the drug, although the effect on the patient of slight poisoning by digitalis has been greatly exaggerated.

It has been usual to give alcohol as a stimulant in cases with soft rapid pulses and a tendency to other signs of heart-failure, and it may be of great value in promoting a sense of well-being in the patient, but if given at all it should be used in small doses, ℥ii-℥iii at a time, repeated every two or three hours, and not more than ℥iv should be given in the day. If it be found that under the influence of small doses of alcohol the pulse-rate does not fall and restlessness is not lessened after twenty-four hours, the advisability of discontinuing the treatment should be considered.

The use of purgatives in enteric fever has been the subject of much discussion, and it is necessary, in this connection, to consider the stage of the disease at which the patient has arrived. If the disease is in a very early stage, say in the

first week, when diagnosis is in doubt, it is not wise to withhold a smart purgative, such as two or three grains of calomel or a table-spoonful of castor oil, or a pill containing Pil. Hydrarg. grs. ii, Pil. Colocynth. et Hyoscyami grs. iii, with Extract. Belladonnæ gr. $\frac{1}{2}$, followed by a saline aperient draught in the morning, simply on the suspicion that the unknown fever may turn out to be enteric, since at that early stage of the disease a single dose of this kind may be given with advantage even in enteric fever. On the other hand, if the diagnosis of enteric fever has been made, frequent purgation by means of salines, Cascara Sagrada, aloes, or powerful mercurials is to be strongly discouraged, as the throwing of the intestine into a considerable degree of peristalsis or greatly increasing the fluidity of the stools by action on the intestinal mucous membrane is bad practice in view of the local lesion. But the present habit which most generally prevails, of moving the bowels only by enemata, has become a little too fixed in the practice of many physicians. Small doses of castor oil, repeated, if necessary, more than once in the day, are quite permissible if they do not cause nausea or griping, while I have seen good results from the giving of small doses of calomel continued steadily for some days or even weeks, during the height of the fever. I do not believe that the use of calomel shortens the course of the disease to any great extent, but in cases treated by calomel, meteorism and abdominal discomfort are, I think, less common than in cases treated only by enemata.

The calomel treatment of enteric fever is best carried out as follows:—Calomel, gr. $\frac{1}{8}$, combined with Resin of Podophyllin, gr. $\frac{1}{40}$, may be given every hour during the waking time of the day, so that some 2 grains of Calomel and gr. $\frac{2}{5}$ of Podophyllin are taken in the twenty-four hours. This should be continued steadily for 3 or 4 days and then be discontinued for tweny-four hours. At the end of each day of calomel treatment the lower bowel should be gently irrigated with warm water to ensure its complete emptying. The irrigation should be done by means of a douche-can and a soft india-rubber tube with a rubber catheter attached. The patient should lie on the left side and have his hips slightly raised.

The water must be boiled and should be at a temperature of 112° F. at the commencement of the irrigation, as tepid or cold water is apt to induce collapse. The patient should be put on Chlorate of Potash, grs. 5, every four hours during the resting period, and at the end of twenty-four hours the calomel should be recommenced . This method of treatment by calomel seems to have no evil result on the local lesion (perforation is rather less common in cases treated thus, and hæmorrhages are no more common), but it is perhaps wise to give no purgatives, even calomel, if the third week of the disease has been entered upon before the patient comes under observation. I have begun the use of calomel in small doses in the third week without any untoward result, but I do not recommend the practice. No other purgative should be given in the third week.

The effect of the repeated small doses of calomel is to induce without pain free and frequent movement of the bowels, 4-5 stools in the day at the end of the first two days treatment being common, with a reduction to two or three later on.

The tongue grows cleaner, and there is seldom any abdominal discomfort or distension in patients treated in this way, and I believe that under this treatment patients assimilate better, relapses are less frequent, and convalescence more rapid and complete, than when the bowels are moved merely by enemata.

Diet.—This should at first, until the fastigium is practically over, be absolutely fluid, save in certain cases which I shall mention later. Water should be given freely, in small quantities of ℥ii or ℥iii at a time, frequently repeated. Milk, plain, flavoured with coffee or tea and sweetened, or diluted with warm water or barley water and slightly salted, should form the staple diet. But it is well to give some clear soup in addition, to the extent of a pint in the twenty-four hours, and if thirst is excessive, water with a few minims of dilute Nitro-hydrochloric acid and flavoured with lemon is sometimes of great service. If there is a tendency for curd to be passed in the stools, Sodium Citrate should be added to the milk to the amount of 5 grs. to the ounce. This "citrated milk" often

makes milk feeding well borne by patients who have been previously intolerant of it. A raw egg switched into milk is a useful addition to the day's food, and is to be recommended in prolonged cases with much wasting and loss of strength. Milk sugar or fine white cane sugar may be added to the milk-feeds in such quantities as may be most pleasant for the patient. The importance of an adequate amount of carbohydrate in the dietary of the enteric patient cannot be too much emphasised. If the fastigium be well advanced and the patient is really hungry and shows no untoward symptoms, small quantities of a well-cooked pudding of milk and rice, or milk and arrowroot, may be given twice in the day. This pudding must be cooked slowly for at least three hours. The detritus from such food is practically negligible and is not likely to give rise to any accident. If, however, it be found that such food tends to produce gastric discomfort or abdominal distension it should be discontinued for a day or two and then tried again. A semi-solid diet of this kind is satisfying to the patient and helps to keep the mouth clean. If a patient can be trusted to masticate thoroughly, the addition of a piece of dry bread daily to his diet during the period of declension is not at all dangerous, but few patients will take the trouble to chew it almost to a liquid before swallowing it, and it is, therefore, wisely avoided in most cases.

Benger's food, Mellin's food, "Allenbury's Diet," Somatose and Sanatogen, are all useful in the period of declension when no complication has interrupted the course of the disease, but I greatly prefer the first three to the more purely nitrogenous preparations.

In a normal uncomplicated case a piece of dry bread may be given after the temperature has been normal for seven days. It has often been urged that this is too early a date to begin feeding as it so often happens that a relapse follows on the giving of food on the 7th or 8th day of normal temperature, but I have noticed that relapses beginning on the 7th or 8th day are just as common when I have been starving patients till the 14th day as when I have been feeding them on a semi-solid diet through the period of declension, and allowed them

to have bread on the 8th day, the fact being that a relapse occurs naturally about that time with great frequency. It is often wise, if the patient is hungry and there is little abdominal distension, to feed through a mild relapse with semi-solid food, especially if the primary attack has been of long duration and the nutrition of the patient is low.

After the patient has been for two days on bread, a little steamed white fish may be given, by preference whiting; and custard, bread and butter pudding, toast and butter, boiled, poached or scrambled eggs, may be added gradually during the next week and at the end of that time chicken, or pheasant if it is in season, may be given, followed in a day or two by a lightly-grilled chop. After the temperature has remained normal for three weeks the patient may be permitted to get up for a short time if his strength permit, and an ordinary light mixed dietary gradually resumed. Alcohol should on no account be allowed to a convalescent from enteric fever.

The treatment of Complications needs some consideration. *Perforation*, *rupture of a suppurating mesenteric gland*, *appendicitis* and *general peritonitis* from any cause demand immediate operative interference. As an example of the results afforded now-a-days by laparotomy in general peritonitis, I append the details of operations performed by Mr. Farquhar Macrae, during the last ten years, in the Fever Hospitals in Glasgow, and furnished to me by him. In considering these, it is to be remembered that in earlier days these complications practically always ended fatally, and, with improved operative technique and after-treatment, especially since the introduction of the semi-upright position, and the stimulus which successful operation has given to early diagnosis, the results are steadily improving. It is as wrong to delay operation when such conditions are suspected as it is to treat diphtheria without antitoxin.

The importance of early diagnosis on the part of the physician cannot be too greatly emphasised, as every hour's delay lessens the chance of successful operation. Where the general mortality-rate of an outbreak is high, the death-rate in cases of perforation will be proportionately as

high or even higher, so that a bad run of cases in a severe epidemic must not prejudice either physicians or surgeons against operation.

The following table shows the results of Macrae's operations in general peritonitis complicating enteric fever, up to the middle of December, 1910:—

	Cases.	Recoveries.
Without perforation or rupture of abscess	10	3
With rupture of mesenteric gland-abscess	2	1
With rupture of an abscess in the spleen	1	1
With perforation of the intestine	53	12
Total	66	17

In all the fatal cases of general peritonitis occurring without perforation or rupture of an abscess, the diagnosis was confirmed by post-mortem examination, except in one case, when permission to make an examination was refused.

Abscesses in the subcutaneous and intermuscular areolar tissue must be opened and dressed antiseptically. They heal, as a rule, slowly, and occasionally occur in cases which ultimately die of asthenia. Particular attention must be paid to the general condition of patients suffering from these abscesses.

Hæmorrhage from the bowel sufficiently severe to render treatment other than simple rest a necessity is best treated by the judicious use of small doses of opium, by the mouth or hypodermically, by the hypodermic injection of repeated small doses of strychnine, by the application of tepid compresses to the abdomen and the injection of a pint of physiological salt-solution into the subcutaneous areolar tissue. I have never seen any good come of the use of lead, tannic acid, or the so-called astringents, or of the administration of ergot, ergotin, or suprarenal extract. Opium, even though it may have no direct effect on the hæmorrhage, is of value in inducing rest and sleep and in lessening peristalsis and the absorption of the products of intestinal fermentation. If given with strychnine it does not unduly relax the intestine

and induce meteorism, which one particularly wishes to avoid in such cases. Tepid compresses on the abdomen seem to have some action in restoring the tone of the gut, and are better than any cold applications, since the surface temperature is lowered and a patient feels chilly if a hæmorrhage is at all large. The injection of a pint of physiological salt-solution into the subcutaneous areolar tissue is of service in two ways, it dilutes the toxins and supplies fluid to the blood to replace that lost by the intestine. The injection may be repeated several times if thought necessary. The physiological salt solution should be carefully sterilised and allowed to run in by siphon action at a temperature of 110° F.

Venous thrombosis, as commonly met with in the leg, necessitates rest of the part affected and of the patient generally. The limb should be elevated, wrapped in gamgee or cottonwool after the skin has been carefully cleansed with soap and water, washed with spirit and powdered with a dusting-mixture of starch, lycopodium and boric acid, in equal parts, and lightly bandaged from foot to hip. Pain should be relieved by opium, either 10-15 minims of Nepenthe or Battley's solution by the mouth, or $\frac{1}{6}$ gr. of morphine hypodermically repeated every two hours until relief is obtained.

Lymphangitis of the thigh or leg must be treated by rest and warmth, and by the painting of the skin over the inguinal glands with tincture of iodine. Pain may be relieved by the application to the limb of hot compresses spread with the glycerine of belladonna, and by the administration every hour of one or two minims of Battley's solution and tincture of belladonna by the mouth.

Cystitis and Pyelitis due to the B. typhosus rarely give rise to much pain or discomfort. The patient should be made to drink large quantities of fluid, and Urotropin in doses of 5 grs. every three or four hours may be given with advantage, while 1 minim doses of Tinct. Belladonnæ every hour will lessen pain and spasm.

Pleurisy and Hæmorrhagic Infarction of the Lung are both productive of discomfort on account of the embarrassment to respiration, and are frequently associated with severe pain.

Opium by the mouth, or the hypodermic injection of morphine should be used, and hot fomentations to the chest wall either simple or having ℥i of Glycerine of Belladonna or of Tinct. Opii spread on their surface are often helpful. The felt-like tissue called spongio-piline steeped in hot water makes an excellent fomentation, but simple flannel, folded several times, does very well. I have used a mixture containing Liq. Morph. Hydrochlor. ℥ii and Tinct. Belladonnæ ℥ii with advantage in both conditions, repeating the dose every two hours until sleep was induced. On one occasion I produced marked poisoning with belladonna in a case of hæmorrhagic infarction of the lung, after six doses of this mixture, but the occurrence fortunately had no bad influence on the patient's progress.

Empyema may follow on either a simple pleurisy or a hæmorrhagic infarction, and must be dealt with surgically.

Peripheral neuritis is best treated during the acute stage by rest and a simple alkaline mixture, such as Liq. Ammon. Acet. ℥i, Potass. Acet. grs. 10 and Potass. Citrate grs. 10. After the acute stage has passed off, mild Galvanism and massage are usually effective.

Typhoid spine must be treated according to the severity of the symptoms and according to its cause.

If a definite perispondylitis is present, absolute rest is essential, and the immobility of the patient should be secured by making him lie between sandbags or on a plaster of paris bed. Pain may be further relieved by opiates. It may be necessary for him to wear a supporting jacket for some weeks after he is allowed up.

If the condition is secondary to a neurasthenic state, the patient must be treated on general lines, and rest, massage and careful dieting will do much towards a cure. Opium should on no account be used, but counter-irritation by mustard-leaves, blisters, or the actual cautery, will usually reduce the pain.

Post-enteric neurasthenia is often very troublesome. The patient should be taken away from work, but, having recently undergone a long period of rest in bed during his attack of fever, it is difficult to persuade him to rest properly. In spite of the fact that he has so recently spent many weeks in bed, it is best at first to send him back to bed for a week or two, feed him carefully and well, and have him massaged. But it is necessary to be careful that the masseur is not too energetic in his manipulation of the legs, as rough treatment may induce a lymphangitis or a phlebitis with consequent thrombosis, and thus delay cure. After a preliminary rest of this kind it is wise to insist on the patient's going away from his usual surroundings for a time, to some pleasant sea-side resort either at home or abroad, where he may have a climate which permits him to be much in the open air at any season of the year. He should not be sent away alone, but should be accompanied by some congenial and cheerful companion who is willing to give him a great deal of attention, and see that he takes exercise well within the limits of fatigue. For people who like the sea, a voyage in sunny latitudes is often very beneficial, but it is unwise to send a patient to sea if there is any marked melancholia, as the opportunities for suicide on ship-board are greater than on land.

If restlessness or any "phobia" be present, a mixture containing Sod. Bromid. grs. 10, and Tinct. Belladonnæ ℥5, is often of assistance, and in sleepless cases it is wiser to be content with what sedative action can be obtained from the bromides combined with suggestion, than to use any more powerful hypnotic drug, since the drug-habit is easily formed in these cases. No alcohol should be permitted, for similar reasons.

Vaccines have been used recently in the treatment of enteric fever, but as yet this practice has not become at all general. The results are, however, sufficiently interesting to encourage a thorough trial of this form of treatment, at least in Hospital. As a remedy for the "typhoid-carrier" or for any long-continued inflammatory process due to the B. typhosus which persists after the fever has terminated, vaccine-treatment offers many possibilities.

Anti-typhoid serum has been prepared by Chantemesse, and according to his results has made some difference in the course and mortality of the disease, but as the serum is not in circulation in this country it is useless to us. Other serums have been prepared, but have not given very encouraging results. The early invasion of the blood-stream in enteric fever may account for this, the serums prepared being mainly anti-toxic and only slightly bactericidal, while the mixed character of the infection may also account for the lack of success of this form of treatment.

Epidemiology.—Enteric fever may be said to be endemic in the British Isles saving in some rural and sparsely populated districts. But it is subject, especially in large urban centres, to definite and periodic epidemic variations. The spring and autumn are the periods of its maximum incidence, the autumn shewing by far the greater rise. Localised epidemics have occurred in connection with the supply and distribution of milk, while water-borne epidemics have been observed even recently in this country. Second attacks are not very common, but do occur, not usually within two years of the first attack.

Method of Infection.—Ground saturated with the excreta of infected persons may retain its infectivity for long periods and may, in the form of dust, spread the infection throughout a whole neighbourhood. It is to be remembered that both the urine and dejecta of typhoid patients are highly infective, and contact with either of them, direct or indirect, must be guarded against. It is often very difficult to avoid infection from the small liquid stools which are frequently passed and are apt to soil the bedclothes to such a slight degree as to be almost unobserved, but which, when dried, are capable of spreading the infection even beyond the immediate attendants.

Period of Infectivity. — The period of infectivity of a case of enteric fever is variable. Usually it has terminated by the time a patient is able to go about again, but it is possible that many

persons may be infective for longer periods, either for a short time through the urine, or for longer periods through the intestinal canal. Cases have been known where a chronic inflammation of gall-bladder, quite without symptoms, or a mild chronic intestinal catarrh, or a slight cystitis have been found to be due to the B. typhosus and have been the means of rendering a person infectious for months or even years after the termination of the original attack. "Typhoid-carriers," as such persons are called, are obviously a danger to the community, and, from their difficulty of recognition, are often the means of infecting very many people with whom they have been in contact. Such a person may be in the service of a dairyman or farmer and may be the mysterious cause of his milk being the origin of an epidemic which may attain wide proportions. The recognition of a "typhoid-carrier" is often difficult. The only certain method is by the isolation of the B. typhosus from the stools, the gall-bladder being the most frequent seat of a concealed infection, or from the urine. Repeated examinations must be made before a negative finding can be of any value, as the presence of the organism in the stools or urine seems to be variable and may be only occasional. Widal's test is a very uncertain method of recognising a typhoid-carrier, since the agglutinating power of the serum in such cases is very capricious, and may be absent for months at a time.

The history of persons who are suspected of being typhoid carriers should be carefully worked out, to discover if they have had any illness that may have been enteric fever, but it must be remembered that certain people are capable of harbouring virulent typhoid organisms, although they themselves are not suffering, and never have suffered, from an attack of enteric fever.

Death Rate.—The death-rate of enteric fever varies very much in different epidemics, tending to be higher at the beginning and lower as the curve of the epidemic increases. It is greater among the poorer classes of the community, partly from the state of their nutrition and their alcoholic habits, and

partly from the fact that the labouring and artisan class struggle on till the last moment, and even when laid up at home, rarely remain completely at rest during the early stages of the disease, and are extremely uncontrolled in the matter of diet. So that a death-rate of 26 per cent. has been noted within recent years in the fever hospital of a large urban district during an autumn epidemic rise. In private practice among better-class patients the death-rate is much lower, and taking it all round, from 7 to 18 per cent. may be said to be a fair average, though the death-rate varies greatly from year to year.

Home Prophylaxis. — A patient suffering from enteric fever can be treated at home only when the house is capable of complete isolation from other houses. In certain flats in the poorer districts of town or country there is no separate W.C. accommodation for each family, but three or four families may share a common latrine. Under these circumstances it is impossible to permit an enteric patient to remain in his own house, and he must be removed to Hospital, if necessary on a warrant. The same rule applies when the patient is staying in an hotel. Where each family is provided with a separate W.C. it is necessary to insist on removal to Hospital only where it is impossible for the patient to occupy a room which is reserved solely for his own use. But it is advisable to remove all patients to Hospital who live in flats, or who inhabit houses where the dejecta are disposed of by means of earth closets, and in most cases it is well, not only for the patient, but for the other inmates of the household, to remove him to Hospital when the accommodation of the house does not permit of a W.C. being reserved solely for the disposal of the dejecta of the patient and his immediate attendants.

Isolation of the patient must be strict, as, although enteric fever is not so easily infectious as measles or scarlet fever, the drying of the dejecta or urine on the bed-clothes makes the dissemination of the B. typhosus throughout the sick-room an easy matter. The sick-room should be arranged as for any other infectious fever, and all the usual precautions

must be observed. Special care must be taken in the disinfection of the motions and the urine. They should be mixed at once with equal parts of a crude carbolic liquid, and allowed to stand for an hour or at least half-an-hour before being permitted to pass into the drains.

Public Health Administration. — This resolves itself, as in the case of all infectious fevers, into the strict isolation of the sufferers, that they may be as little as possible a source of danger to the community. Careful enquiry must be made into the history of the illness, and all those who have been in close contact with the sick person before and during the period of incubation must be seen, as it is in this way that ambulatory or mild, unrecognised cases and "typhoid-carriers" are sometimes discovered. The milk and food supply of the household must be noted and investigated, as one or two cases having the same milk supply occurring in a district throws suspicion on the dairy or the milk-shop.

A frequent cause of a milk-epidemic is that one of the assistants in a dairy-farm or milk-shop may be suffering from an unrecognised attack of enteric fever, or may be in close attendance, when not at work, on a relative who is suffering from a disease which turns out to be enteric fever, although this diagnosis may not have been made until the occurrence of other cases. The drainage of the patient's house and the hygienic conditions obtaining at his place of work must be investigated and necessary alterations made. The bed-clothes and mattresses, and everything portable which has been in contact with the patient and his attendants must be disinfected after the convalescence of the patient, and the sick-room should be washed over with formalin and re-papered. Cotton and linen stuffs and blankets should be boiled, mattresses treated by steam, and furniture, if stuffed, subjected to a formalin-spray, while it may be sufficient in the case of books and papers to use vapour of formalin, taking care that they are so placed that the vapour can reach every part.

The improvement of sewage-disposal, the opening up of congested districts, the paving of back-courts with impermeable material, the inspection of W.C.'s to see that they are

kept clean and in good order, the insistence on public cleanliness on the part of everybody and the constant urging on them of personal cleanliness, are all points to which the Health Authority of a district must pay attention if their work is to have any good result in lessening the incidence of enteric fever.

Chapter III.

DIPHTHERIA.

Synonyms.— Membranous Croup.
Fr.: Diphthérie.
Ger.: Diphtherie.

Definition. — An acute infectious fever characterised by a local lesion of the fauces, tonsils, and the air-passages generally, associated with a prolonged and severe toxæmia, with frequent paralytic manifestations. The disease is due to an invasion of the fauces and air passages by the Bacillus Diphtheriæ, discovered by Klebs in 1883.

Incubation Period. — The incubation period is usually described as from one to seven days, but it is extremely difficult to fix the maximum. I have known of a child who having been exposed to infection was observed for a fortnight after the B. diphtheriæ was isolated from his throat, and during the fortnight he remained quite well. After that time, however, he developed a typical attack of diphtheria under the eyes of his father, who was a medical man, and whose zeal for observing the behaviour of the bacillus outran the discretion which he should have displayed for his child's sake.

Rash. — No rash has been observed as typical of the disease.

Period of Invasion. — This is usually very short, amounting only to a few hours. The patient feels slightly chilly, depressed and languid, may suffer from some headache and nausea and is almost at once conscious of sore-throat. The depression is often severe, and the patient may be quite

prostrated within an hour of the first feeling of malaise. The pulse is frequently rapid out of all proportion to the temperature, but may be slow, and tends to be very soft. The face is rarely much flushed, and the fever is usually moderate, 100°-102° F.

Clinical Types. — From the beginning of the appearance of symptoms the local lesion is apparent either in the nose, fauces or larynx, and according as one or other of these parts is the primary seat of the local lesion, the attack of diphtheria is called "nasal," "faucial" or "laryngeal." The faucial type is by far the most common. The local lesion is characterised by the formation of a "false membrane" on the parts affected. This "false membrane" is produced by the degeneration, necrosis and desquamation of the epithelial layer of the mucus membrane with exudation of fibrin, the result of the local action of the toxins of the B. diphtheriæ. Microscopically it is seen to consist of a net-work of fibrin with some red blood cells and leukocytes entangled in it, with much epithelial *débris* and numerous clumps of bacteria, the B. diphtheriæ, non-pathogenic bacteria of the mouth and, frequently, the staphylococcus albus or aureus and masses of streptococci. In striking contrast to enteric fever, the invasion of the blood-stream by the bacillus diphtheriæ is not at all common, and while occasionally the bacillus has been found in the spleen and kidney, the widespread lesions met with in diphtheria are due to the action of toxins circulating in the blood-stream and manufactured by bacilli which occupy a superficial situation.

Faucial Diphtheria.—The usual site for the membrane is on one or both tonsils, the uvula, the posterior pillar of the fauces, the soft palate or, rarely, on the posterior pharyngeal wall. On examining the throat, the fauces are found to be congested and reddened and in the neighbourhood of the membrane especially the parts are swelled and angry-looking. If the membrane be situated on the tonsil, the tonsil is distinctly enlarged, and tender to pressure from outside. The appearance of the membrane on the first day of illness varies

very much in different individuals. In some it may appear only as a faint whitish semi-transparent film on the inflamed mucous membrane, in others it appears as a thick white opaque firm-looking growth, like the outer skin of a mushroom. As days go on it grows yellower and thicker, while the central portions of the growth become dark and the peripheral parts tend to curl up like carelessly dried wash-leather. If left unchecked the membrane may spread all over both tonsils, the uvula, the pillars of the fauces, the soft palate and posterior pharyngeal wall, extending upwards into the naso-pharynx and downwards into the larynx and bronchi. Such wide spreading of the membrane is seldom seen at the present time, unless the child has been kept at home without seeing a physician for many days after the onset of symptoms. The membrane may appear at first as only one patch which spreads, or it may show itself as numerous small dots of yellowish grey, not unlike the exudate in follicular tonsilitis, which afterwards coalesce to form a plaque. If any exudate resembling the above descriptions be present on a tonsil it is wise to strip a little of it off for purposes of diagnosis. If the surface from which it has been stripped is raw and bleeds, the presumption is that the condition is diphtheritic.

The general appearance of the patient is not like one suffering from an acute fever. There is seldom any flushing of the face, which is usually pale and presents an expression of exhaustion and languor. The lips may be a little livid, apart from any laryngeal obstruction, and in profoundly toxic cases, the pupils are much contracted. The whole appearance and attitude of the patient is one of extreme exhaustion and relaxation, and it is always a surprise to the student, on seeing his first case of severe diphtheria, to realise that the pallid cachectic patient before him may have been in apparently good health less than twenty-four hours before. The temperature is very moderate, except when the local lesion is complicated by much pyogenic infection, but the pulse is usually rapid and weak.

Sometimes the temperature may not rise above 100° F. I have seen this in rapidly fatal cases, and it is well to realise that the gravity of an attack of diphtheria cannot be measured

in the least degree by the height of the fever. There is very frequently enlargement of lymphatic glands in the neck, and pressure over these glands usually produces some pain.

The progress of the case now-a-days depends very much on how long the disease has lasted before its recognition by a physician, because it is now, or should be, the ordinary practice, immediately after recognising a case as diphtheria, to give an adequate dose of antitoxin, and in some 12-24 hours after giving the antitoxin the condition of the patient shows a marked change for the better if treatment has been begun within the first forty-eight hours after the appearance of symptoms. The patient grows more alert in appearance, the pallor lessens, the pulse slows somewhat and the temperature begins to fall, while the appearance of the membrane undergoes a change. It becomes more translucent and less solid in appearance, and there is a distinct diminution in the surrounding inflammation. Pain is lessened and the tenderness over the cervical glands diminishes. Within three or four days the membrane disappears and the patient begins slowly to recover strength, although in many instances it may be weeks before he ceases to suffer from a feeling of great prostration, and he may continue to be easily tired for months. In children it is noticeable that even after a mild attack of short duration their convalescence is slow, they may remain pallid and listless for weeks, and exhibit a feebleness in walking out of all proportion to the apparent severity of the attack, even though there have been no paralytic manifestations. The membrane may separate in a mass and be coughed up in fairly large pieces, but it is more common, where due attention is paid to the care of the mouth, to find that it gradually fades, becoming less thick and opaque until it appears as a slight semi-transparent film on the surface of the mucous membrane similar to its appearance at a very early stage in the disease. It is sometimes difficult to say exactly on what day the membrane disappears when it fades in this way and does not separate *en bloc*.

When, however, several days have elapsed between the onset of the illness and the giving of antitoxin in adequate doses, the course of the disease is not so mild and uneventful,

even when the type is simply faucial. It is not uncommon among the poorer and more ignorant classes of the community to find that the initial sore throat is disregarded by the parents and it is only when after four or five days' illness the child's condition becomes alarming that the physician is called in. Under these circumstances we have to deal with a condition not much less alarming than diphtheria used to be in the pre-antitoxin days, since much of the toxin has become fixed by the tissue-cells and is beyond the reach of any antitoxic serum. It is still no uncommon thing to find such a patient in a state of the gravest asthenia, with a membrane spread widely over the fauces and tonsils, presenting an ugly greyish appearance with dark central areas and associated with a great deal of oral sepsis, foul tongue and sordes on the lips and teeth. The pulse is rapid, extremely soft, and often irregular; the urinary output may be low; the child may have a tendency to vomit; the pupils are contracted; and the whole aspect of the patient indicates an extremely grave toxæmia. Even though antitoxin, in full doses, may be given at once or within a few hours, the progress of the case may be quite unsatisfactory. Despite all efforts, the membrane, while perhaps showing no sign of further spreading, may persist for many days and the child may die of toxæmia within a week.

It is in this class of case that slow cardiac failure occurs. The heart grows gradually weaker, the extremities tend to become cold, the capacity for taking even the lightest form of food grows less and vomiting may be frequent. Death may ensue suddenly as the result of cardiac failure due to the strain of vomiting, or the heart may grow gradually more feeble and rapid until death occurs from asthenia. Some cases may linger in this toxæmic condition for a fortnight or more and may display paralytic manifestations either of the heart or of other muscles, or may develop a low form of broncho-pneumonia and ultimately die. If recovery does take place, it is only after a long and tedious convalescence.

Nasal diphtheria.—This has always been recognised as a particularly dangerous type of the disease and it is easy to understand why it should tend to be more serious and more

fatal than the ordinary faucial type. The nasal cavities are inaccessible and difficult to see properly, and they are also difficult to clean by direct applications. Thus a nasal diphtheria may proceed far without recognition, and concomitant pyogenic infection is usual and not easy to deal with. Unless, by some fortunate chance, membrane forms just within the nostril and is visible on superficial examination, there is nothing to make a physician suspect that this somewhat severe nasal catarrh with rather profound constitutional symptoms of depression is due to the B. diphtheriæ. It is only when the extreme prostration of the patient and the sanio-sanguinolent nature of the nasal discharge makes it evident that something out of the ordinary is happening, that the physician suspects a nasal diphtheria and makes a culture from the nose for diagnostic purposes, unless it is known that the patient has been previously in contact with a case of diphtheria. Unless the physician has had some experience of diphtheria, it is frequently the case that the discharge of a piece of membrane is the first sign which makes him suspicious. By this time, of course, the disease has been in progress for many days and the toxæmia is profound. Beyond this difficulty in recognising the condition early, I do not see that a nasal infection is worse than a faucial one, but from what has been said before it will be seen that every day lost in making a diagnosis and beginning antitoxin treatment means greatly increased risk to the patient, and it is this delay in diagnosis that makes nasal cases appear to be so malignant.

Laryngeal diphtheria.—Similarly, in the case of the laryngeal type of the disease, on account of the impossibility of viewing the larynx by ordinary means, diphtheria is naturally not suspected until the exudate in the neighbourhood of the cords is sufficient to cause some degree of stenosis, and even then time may be lost because a simple croup may be diagnosed in the first instance, and thus a dangerous delay in beginning treatment is incurred. But besides this danger, which is common both to the nasal and laryngeal types of the disease, there exists the danger of laryngeal obstruction with all the strain and loss of aeration which follows and which calls for special treatment. The laryngeal form may be secondary to

a primary faucial diphtheria either by direct extension of the membrane downwards, or to a secondary infection of the larynx without there being actual continuity between the membrane on the fauces and in the larynx.

The signs which are suggestive of laryngeal diphtheria are those of a greater or less degree of laryngeal obstruction, combined with the usual toxæmia of the disease, and it is on this combination that the great danger of this type of the disease depends. We shall see under the section on treatment how not only the degree of laryngeal obstruction but the effect of that obstruction on a poisoned body has to be taken into consideration, so that in some cases where the laryngeal obstruction may be at the moment comparatively slight but the toxæmia severe, immediate tracheotomy is called for, while in other cases with a great degree of laryngeal obstruction the toxæmia may be comparatively slight and tracheotomy may be delayed with safety. It is a good rule to be anxious about those cases with diphtheria of the larynx who, while showing signs of laryngeal obstruction, have a pale face, a soft and rapid pulse, perhaps a little irregular, and contracted pupils and who are quiet and feeble-looking. A great degree of cyanosis in a child even with marked signs of laryngeal obstruction need not cause the same anxiety if he seems capable of effort and has a strong, regular pulse, albeit rapid. The amount of retraction of the lower intercostal spaces, the lower ribs and the lower end of the sternum during inspiration gives, in a child, a fair indication of the degree of laryngeal obstruction.

Another danger in connection with laryngeal diphtheria is the tendency for broncho-pneumonia and catarrh of the smaller bronchi to occur, either due to invasion by the B. diphtheriæ or to a secondary pyogenic infection. Sometimes the trachea, bronchi and even bronchioles are found *post mortem* to be covered with the typical "false membrane," and occasionally a complete cast of trachea and bronchi is coughed up during life as the membrane separates. Such happenings are rarer now that the use of antitoxin has become more general. The separation of a large piece of membrane in the trachea or larynx or the inhalation of a

large piece of membrane separated from the fauces may sometimes give rise to laryngeal obstruction, and necessitate immediate tracheotomy.

Aberrant types of Diphtheria.—The primary local lesion may sometimes be found not in the air-passage or fauces but on the vulva, the conjunctivæ, the lip or on some wounded surface. In these situations the general symptoms are usually slight, and the disease is troublesome mainly because others may acquire diphtheria of the faucial, nasal or laryngeal types from such conditions while undiagnosed.

Differential Diagnosis.—The diseases most likely to be confused with diphtheria are *acute tonsillitis, scarlatina, measles, simple catarrhal laryngitis,* and some cases of *croup.*

In *acute tonsillitis* the pain is much more severe than is common in diphtheria, where pain is usually moderate and may be absent. Acute tonsillitis, too, is commonly accompanied by high temperature, a flushed face, a full bounding pulse and all the common signs of fever. As in diphtheria, however, the cervical glands are apt to be enlarged, but are usually much more tender. The follicular exudate may simulate very closely the diphtheritic membrane in its early stage and an exudate firmly adherent over a portion of the surface of the tonsil or posterior faucial pillar or a superficial slough, may also present a very suggestive appearance; but exudate can usually be easily removed by swabbing the throat, leaving no bleeding surface behind, while a superficial slough is not so easily stripped off as the false membrane, and when easily separated, seldom leaves the raw bleeding surface which is seen on stripping the membrane in the early stages of diphtheria.

But in many cases the differential diagnosis apart from bacteriological examination is practically impossible.

Similarly, a case of scarlet fever in which the rash has been so slight as to escape observation and where desquamation has not yet begun may be difficult to differentiate without a bacteriological examination. The character of the tongue may help, as a "strawberry tongue" is not met with in diphtheria, but the superficial ulceration covered with exudate which so commonly appears on the tonsils may closely simulate

the false membrane. It is best in all cases of doubt to have a swab from the throat examined by culture before a diagnosis is arrived at, but where there is a reasonable possibility that the disease is diphtheria it is advisable to give antitoxin on suspicion.

Measles may in the early catarrhal stage simulate laryngeal diphtheria through the occurrence of a laryngitis with signs of obstruction, but the facies of the patients are very dissimilar. In measles there is usually a flushed, bloated face with coryza and lachrymation, and "Koplik's spots" are a help towards differentiation.

For bacteriological diagnosis a swab of the suspected part must be taken with sterilised cotton-wool and placed in a sterile test-tube stopped with sterile cotton-wool for examination by culture. In taking the swab, great care must be taken to avoid touching the tongue and the teeth. At the same time a smear should be made on a glass slide from the suspected part, dried, and sent with the swab for examination by a competent authority. At the present time, practically all Medical Officers of Health are accustomed to carry out such examinations, or have a bacteriologist connected with their department whose duty it is to aid the practitioner in this way, so that practitioners working even among the poorest classes of the community have little reason to be long in doubt in these cases.

A test tube can be roughly sterilised by a few minutes boiling, and cotton wool pulled out from the centre of a roll with hands that are surgically clean will be sufficiently sterile to be used as swab and stopper, in such districts where suitable apparatus is not supplied gratis by the Local Authority.

Where it is impossible to have such an examination done in reasonable time by the Local Authority, a smear from the suspected throat should be taken on a glass slide and stained by Neisser's method, which roughly differentiates the B. diphtheriæ from the pseudo-diphtheria group of organisms which are found both in health and disease in the throat, nose and conjunctival sac. Staining with ordinary methylene blue or other aniline stains is not sufficiently accurate, even for an approximate diagnosis.

Complications.—The complications of diphtheria most commonly met with are *secondary pyogenic infection of the throat, otitis media, nephritis, bronchial catarrh, and broncho-pneumonia.* The multiple neuritis so frequently met with at all stages of the illness can hardly be called a complication or a sequel, and will be described under the heading of *diphtheritic palsies.*

Secondary pyogenic infection of the throat is often a troublesome complication and adds danger to an already dangerous condition, since the toxins elaborated by pyogenic organisms are not influenced in any way by the antitoxin, and throw an extra burden on the overtaxed system. The pyogenic infection often causes extensive sloughing of the tonsils and soft palate and may be associated with *acute otitis media* and *inflammation of the cervical glands,* and, possibly, suppuration of these glands.

Otitis media may occur apart from any marked secondary infection of the throat and may be due to the B. diphtheriæ itself, although it is usually associated with the Diplococcus of Fraenkel or one of the ordinary pyogenic cocci. It is not accompanied, as a rule, by the same amount of pain as is met with in a similar condition arising in association with scarlet fever or quinsy, and usually clears up without the necessity for operation.

Nephritis is not a common complication. A slight albuminuria is very frequently met with, but is of a "toxic" type, comparable with the ordinary "febrile albuminuria," and is not associated with any grave lesion of the kidney. In such cases casts are seldom seen in the urinary sediment. Occasionally, however, a profuse albuminuria occurs, with numbers of casts and perhaps a little blood, and in these cases it is reasonable to suppose that either the kidney, as does happen sometimes, is invaded by the B. diphtheriæ, or that the toxæmia is sufficient to produce a serious degeneration of the renal epithelium.

Slight *bronchial catarrh* is quite common in diphtheria, but if the case has been brought under treatment early it does not as a rule give much trouble. If, however, treatment

has been instituted late, bronchial catarrh and a low type of *broncho-pneumonia* are often troublesome and dangerous complications, and are particularly dangerous in cases where tracheotomy has been performed. This may be due to an infection by B. diphtheriæ, or to a secondary infection by the pneumococcus or one of the pyogenic cocci.

Vomiting induced by taking food is sometimes a very dangerous complication, not only because of the inanition which results from insufficient feeding, but also on account of the severe cardiac strain induced by the effort. In some cases vomiting follows on any attempt to swallow even liquids, and so immediately does it follow the act of swallowing that it has been thought that it is due to the irritation of food passing the fauces. This idea is supported by the fact that feeding by the nasal tube may result in a cessation of the vomiting, and that when it is discontinued the vomiting returns.

Sequelae.—Besides the various paralytic manifestations, the most common sequelæ are *cardiac weakness* due probably to fatty degeneration of the heart muscle, some degree of *general muscular enfeeblement* and a marked *cachexia* which may persist for months after an attack of diphtheria.

Cardiac weakness is very common after an attack of diphtheria even of moderate severity, and produces considerable breathlessness on slight exertion and often a marked degree of palpitation and præcordial discomfort. It is possible that some of the sudden deaths which have been noted as occurring weeks after the subsidence of all local signs may have been due to heart-failure following on an extensive fatty degeneration of the cardiac muscle.

General muscular enfeeblement is, of course, common after all febrile conditions, but it is so much greater and of longer duration after diphtheria than after almost any other of the infectious fevers that it appears worthy of special mention. So profound is the effect of the toxins of diphtheria that a patient may be muscularly inert and easily exhausted for many months after the usual period of convalescence. The pallor and anæmia which follow on diphtheria are frequently

obstinate, especially in children of 8-14 or thereabouts. Younger children are not usually affected to the same degree. It has been suggested that this cachexia is partly due to the effects of antitoxin, but it is more probable that we see more of the post-diphtheritic cachexia than in pre-antitoxin days because more serious cases survive now than formerly.

Diphtheritic palsies. — Palsies of various groups of muscles are common in all stages of the disease after the first few days, and are due to a peripheral neuritis caused by the action of the diphtheritic toxins. The most common form is paralysis of the palate, usually unilateral on the same side as the local lesion. The paralysis is of very varying degree, from a slight drooping and immobility of one side, without any alteration in voice or difficulty in swallowing, to a complete paralysis of the whole soft palate with nasal speech and regurgitation of food into the nose on attempting to swallow. A palatal palsy may occur as early as the first week of the disease, especially if the local lesion is extensive and several days have passed before the commencement of treatment, but it may appear at any time up to the third or fourth week. If there be much tendency to regurgitation of food into the naso-pharynx it may be necessary to feed for some time by the nasal tube, to avoid the risk of an inhalation-pneumonia.

Another early manifestation of diphtheritic palsy is the occurrence of squint, particularly internal squint, due to palsy of the external rectus muscle. This is very often the first indication of a paralysis which may in the end affect profoundly many groups of muscles and prolong convalescence for many months beyond the usual period.

Of the limb palsies, that of the peroneal group is perhaps the most common, and next to that, palsy of the extensors of the wrist, but the whole limb may be profoundly paralysed. On rare occasions a palsy, more or less profound, of all four limbs may occur, or, rather less rarely, a paraplegia. In two cases of hemiplegia which I have seen as a result of diphtheria, there was at first, besides a profound palsy of an arm and leg on the same side, a slight but distinct

loss of power in the arm and leg of the other side, which cleared up in a few days. The multiple neuritis of diphtheria is rarely associated with pain or tenderness in the affected parts.

The prognosis is usually good, although in severe cases months may elapse before complete recovery. In a few cases, however, a palsy of the diaphragm has resulted in death, and in many instances a sudden cardiac failure has occurred early in the disease, presumably from paralysis of the vagus. Before such sudden cardiac failure the pulse has been found to have been weak and irregular, and as sudden cardiac failure has in most instances followed on injudicious movement on the part of the patient, any irregularity of pulse in diphtheria should be considered as a grave sign which may be the forerunner of serious accident.

Diphtheritic palsies usually occur within four weeks from the onset of the illness, but I have known many cases where no paralysis was observed until six or even eight weeks had elapsed. There is little doubt that the incidence of paralysis has been greatly lessened by the introduction of the antitoxin treatment properly carried out, although in the earlier days of the treatment it was thought by many that slight palsies were even more frequent than formerly. This was probably due to the fact that antitoxin was given in quite inadequate doses, so that, while the death-rate was lowered, the process of cure in many cases was comparable with that of the more severe cases which recovered in pre-antitoxin times and was attended with many of the accidents which were then met with, so that, many more grave cases having recovered, the incidence of accidents among all cases treated naturally appeared to be greater.

Treatment. — The main points in the treatment of diphtheria are careful and absolute rest in bed during at least the first three weeks of the disease, and the proper use of antitoxin. Absolute rest in bed is most essential until all risk of cardiac failure may reasonably be supposed to be over, that is until three or four weeks have passed. In the first fortnight the patient should be allowed

to do nothing for himself, and the bed pan and the bed urinal should be used. He must be watched, and, if old enough, warned, lest any injudicious movement induce an attack of heart-failure.

It is unwise to allow a patient to get up until at least three weeks have elapsed, and if the attack has been at all severe it is best to keep him in bed for four weeks. In really bad cases, of course, it may be necessary to keep him in bed much longer, especially if there have been any complications or palsy.

But it is in the use of anti-diphtheritic serum that the chief treatment of diphtheria lies, and to be successful one must not only use the serum but use it properly. The serum now used is standardised in "units," and accurate dosage is thus rendered possible. The principle of dosage should be to neutralise the circulating toxins as quickly as possible, so that none may be left over to be fixed by the tissue cells, because when once a toxin molecule is fixed by a cell it cannot be neutralised by an antitoxin either injected or produced in the body. If Ehrlich's theory is to be accepted even as a working hypothesis this must be apparent, and, despite all statements to the contrary by older practitioners, there is no doubt that the minimum dose of antitoxin, even on the first day of the disease, should be from 6,000 to 10,000 units, and if two or three days have elapsed since the onset of illness, from 10,000 to 20,000 units should be injected. It is infinitely better to give only one dose than to give repeated doses at intervals of twenty-four hours, not only because it is not right to allow the toxin to have a greater opportunity of fixing itself than is necessary, but because it is not well to subject the patient to the irritation of repeated injections. The injection is usually made subcutaneously in the flank, and this is a convenient situation, as it is least subject to friction and pressure while a patient is in bed. This is the objection to the loose tissue between the shoulders as the site for injection.

In cases which have been ill for many days before being seen, the practice of intravenous injection has been adopted by some with apparent success. The usual method is to plunge

the needle of the syringe directly into a vein in the bend of the elbow. The process is a difficult one in the case of children on account of the small size and thin walls of the veins. I know of no untoward result following this practice save in a case of my own, when a boy died suddenly within ten minutes after an intravenous injection had been given. The cause of death in this case is unknown, but I confess that the occurrence made me fight shy of intravenous injections from that time.

One interesting point to be remembered in connection with serum treatment is that for some time after injection certain patients become unduly sensitive to horse-serum. This is important in considering the advisability of giving a second dose of serum on the occurrence of a second attack within a few weeks or months of a first, and is also a fact to be recorded against the habit which certain physicians have of giving more serum on the occurrence of a palsy. In the latter instance the giving of serum is probably futile, as considerable fixation of the toxin molecules has already taken place, and it is unlikely that the neutralisation of the small amount of free toxin which possibly remains in circulation will have any effect in arresting the palsy. If a full dose of serum be given to a patient who is hypersensitive, a condition of *anaphylaxis* is produced; that is to say, certain alterations take place in the behaviour of the ordinary phenomena of "serum-disease" which will be discussed later, and profound constitutional disturbances, collapse and even death may ensue.

This condition of hypersensitiveness to horse-serum may begin about a fortnight after a full dose and continue for some months or even years, so that it is wise not to give a second full dose of serum within these limits without taking certain precautions. It is said that danger from anaphylaxis may be avoided by the giving of a very small dose of 50 or 100 units of antitoxin twelve hours before the full dose, when a patient has shown himself susceptible to serum-disease within a few years previously.

Serum disease is the name given to those constitutional and local symptoms which follow the injection of antitoxic sera derived from the horse, as in diphtheria and plague. The

most common results are the occurrence of an urticarial rash both at the seat of the puncture and on the body generally. The rash is often morbilliform, often scarlatiniform, and, like all other so-called "toxic" rashes, has a tendency to be most marked about the joints. Whether morbilliform or scarlatiniform, it is inclined to appear in blotches and is often intolerably itchy. The appearance of the rash is frequently associated with headache, nausea and general malaise, and occasionally with some rise in temperature, which, however, is rarely very high unless, as sometimes happens, there is besides the above-mentioned symptoms, some pain in the joints. The joint-pains in serum-disease, associated as they frequently are with fairly high fever and considerable constitutional disturbance, may closely simulate an attack of acute rheumatic fever, but they are not commonly so severe and may only exist as a very slight affection indeed. They attack as a rule those joints on which most strain falls in the patient's occupation, and are accompanied by slight swelling which is mainly peri-articular, but in some cases, fairly large effusion into the joint or neighbouring synovial pouches has been observed. Serum disease usually appears some 8-14 days after the injection of serum and lasts for about a week or less, but in rare cases relapses occur and repeated outbreaks of rash with fever and joint-pains may be observed, separated by a few days of normal temperature and freedom from symptoms.

When a patient has been *hypersensitised* by a previous injection of serum, the phenomena of serum disease appear rapidly, almost without any incubation-period, so that rash, malaise, headache and fever may show themselves within a few hours of the injection. The constitutional symptoms of hypersensitised patients are usually much more severe than in those who have had no serum previously and may, indeed, give cause for grave alarm from the collapse from which the patient suffers. In several instances death has followed an injection of serum when the patient has been in this condition of *anaphylaxis*.

Local treatment of the throat and nasal passages must be carried out with some care, but no attempt ought to be made

to remove the membrane or apply strong disinfectants to the throat, on account of the pain and discomfort which this entails on the patient. The fauces may be sprayed frequently with a warm solution of Sod. Bicarb. or Sod. Biborate, and the mouth and fauces may be swabbed out several times a day with a mixture of Glycerine of Borax and warm water, but strong carbolic preparations or other powerful local antiseptics should be avoided, unless there be a great deal of secondary pyogenic infection.

In a case of laryngeal diphtheria, the possibility of *tracheotomy* being necessary is always present in the mind of the physician, and the attitude towards this operation has changed very greatly since the introduction of the antitoxin treatment. Formerly, on account of the tendency of the membrane to spread to the cut surface, it was only performed as a last resort, and many practitioners, both in hospital and private, had given it up altogether on account of the appalling mortality which attended it. But now, when spreading of the membrane is practically unknown after adequate doses of antitoxin, the operation holds out chances of success which rob it of its terrors, and while its mortality-rate is, naturally, rather high, it is not such as to make a practitioner hesitate in its performance. The question is, when should the operation be performed, and when should a chance be given for the swelling of the cords to subside under the influence of antitoxin and other treatment?

It is to be remembered that in many cases the apparent obstruction is increased by spasm, and many of the symptoms are the result of fear on the part of the patient. Unless the obstruction is very marked, as evidenced by much indrawing of the intercostal spaces, and the lower ribs and lower end of the sternum in children, with a great degree of cyanosis or exhaustion on the part of the patient, or unless a fair degree of obstruction is present in association with a very profound toxæmia indicated by a "pale lividity" of the lips and face, coldness of the skin generally, and contraction of the pupils, it is wise to wait for some hours after giving antitoxin, in the hope that some amelioration of the symptoms will take place.

In the meantime, a dose of ʒi-ʒiv of whisky, according to the age of the child, in hot water with sugar, or the hypodermic injection of a small quantity of morphine, say from $\frac{1}{12}$th to $\frac{1}{6}$th of a grain according to age, will help to reduce the extra obstruction due to spasm and quiet the restlessness of the patient, and the surrounding of the bed with an improvised tent into which steam is led by a funnel from a boiling kettle, will ensure the warm moist atmosphere which is necessary for those who suffer from an acute laryngeal inflammation. During this time of waiting the physician should be in close attendance on the patient and all should be in readiness for the performance of the operation, since it is quite usual for a sudden spasm to occur which may threaten the life of the patient should the operation be delayed longer than ten or fifteen minutes. One must remember that in the laryngeal obstruction of diphtheria a child is handicapped for the fight by a toxæmia which has a profoundly depressant effect on the heart, and he cannot, therefore, endure much struggling. If, after a few hours of palliative treatment, the conditions are no better but rather worse, the operation should be performed without further delay.

To those who have had much clinical experience of diphtheria it is comparatively easy to decide when the operation is necessary, but to those whose clinical experience is yet small, I would say that it is better to be too early than too late; it is better to operate sometimes needlessly than to have a patient die with laryngeal obstruction without tracheotomy having been performed.

The instruments necessary for the operation are few. A small scalpel with a keen edge, a couple of artery forceps to retract the edges of the wound, a blunt retractor to pull down the isthmus of the thyroid should it be in the way, some pressure forceps to stop excessive bleeding should a large vein be cut, and some sterile ligatures, are all that is necessary. When the child is unconscious no anæsthetic will be required and, indeed, when there is much cyanosis, the sensation of the child is so blunted that the pain of the operation is slight, and the patient can be easily controlled. But when the child is strong

and struggles much, a small quantity of chloroform is necessary to keep it quiet, and the risk of accident is so remote that it is quite outweighed by the additional comfort to the operator and the increased chances of rapid and successful operation. I have never seen any evil result from the careful administration of chloroform in small quantity by the "open" method, even in profoundly "toxic" cases, but I have seen a child's heart fail after much struggling where the operator feared the anæsthetic. When the practitioner has had much experience of the operation it is extraordinary how rapidly it may be done even with a struggling child, but when he has had little experience it is wiser to be slow and certain than to attempt rapidity and cut what should not be cut or lose the trachea for a time. I do not propose to describe the operation, but I would say this, that much of its success depends on the incision through the skin and subcutaneous tissue being accurately in the middle line as, if it has been made a little to one side, the search for the small soft trachea in the fat neck of a child is often irritating and disconcerting.

In an adult, tracheotomy is rarely necessary in diphtheria, and should a sudden alarming obstruction occur, it may be rapidly relieved by putting a knife through the crico-thyroid membrane, an operation which can be done in a moment and involves no preparation or anæsthesia.

The after-treatment of a tracheotomy is important. Care must be taken to keep the tube moist and free, by covering the opening with a hot moist sponge which should be frequently changed during the first twelve hours after the operation, and secretion should be encouraged by a hot alkaline steam sprayed into the opening of the tube every few hours. The inner tube should be removed and cleaned at least twice in the day, and if loosened membrane gives rise to any obstruction it may be removed by cleaning the outer tube with a feather or sucking it out with a syringe and rubber tube. It may be that the tracheotomy tube will have to be taken out, and if this is the case the wound must be held open by a double retractor, while the trachea is cleaned. At the end of the first day after operation the inner tube should be taken out

and the end of the outer tube should be covered and trial made of the patient's capacity to breathe through the larynx. Similar trials should be made at intervals of twelve hours, and between two and three days after the operation the tube may be removed and as a rule does not need to be returned. In some cases, however, the patient may have difficulty in breathing again and reintroduction of the tube may be necessary for twelve hours. Roughly speaking, the shorter the time the tube remains in the larynx the better, as if it has to remain for a long time troublesome granulations may appear in the trachea and may require special treatment. Sometimes the introduction of a larger tube for a day or two is sufficient to check these granulations, but occasionally they require scraping or treatment with "blue-stone."

As a general principle, the tube used should be as large as can be introduced into the larynx without distress. The wound should be cleaned twice daily with a saturated solution of boric acid and a piece of boric lint should be placed under the flange of the tube. After the tube is removed, the wound may be covered with sterile gauze, dusted with powdered boric acid crystals, and kept in place by a light gauze bandage. The wound usually heals in about a week after the tube is removed. In a few cases patients have been known to acquire a "tube-habit" and seem unable to give it up for many weeks. I have tried to trick certain of them by removing the tube rapidly during sleep and have noticed that breathing was perfectly easy and natural while they were unconscious, but when they woke and found the tube gone, an attack of laryngeal spasm came on. It is a good thing to make such a patient wear a corked tube for some days before trying to train them to do without it altogether.

No trouble results, as a rule, from the contraction of the scar left after the wound heals, but one or two cases have been recorded where a cicatricial stenosis of the larynx has occurred.

Intubation has been urged by many as a substitute for tracheotomy in many cases. It is possible that in skilled hands and in hospital practice it may be attended with small

risk, but even under these conditions, where the tube, if dislodged, can be quickly replaced by the physician in charge, intubation has frequently to be followed by tracheotomy. In private practice it is not to be recommended. The operation requires a considerable amount of training and manipulative dexterity, and one cannot expect a nurse to replace a dislodged intubation tube, so that the proximity of the practitioner is necessary to a degree impossible for one engaged in a practice of any size. After tracheotomy, on the other hand, the tube, if dislodged, can be replaced by any nurse who has had an ordinary training in fevers, and the practitioner is able to do his work properly without the danger of impossible calls on his time. The objections to intubation in this way are very practical, and the operation has not taken hold in this country for these reasons. However, if a practitioner is able to devote the time necessary to one patient, intubation will be found, in a certain number of cases, to obviate the need of tracheotomy, when otherwise the major operation would have to be performed.

Treatment of Complications.—*Secondary pyogenic infection of the throat* with ulceration must be treated as in Scarlet Fever. (q. v.)

Otitis media yields readily, as a rule, to swabbing out the ear with some antiseptic cotton-wool and insufflation of boric acid powder. I have never seen mastoid abscess or periostitis following a diphtheritic otitis media.

Broncho-pneumonia and Bronchial catarrh must be treated on general lines. If there is much embarrassment of breathing, heat over the chest, especially in young children, will often relieve it, and a mixture of Acetate of Ammonia ℥ss-℥i with Ammon. Carb. grs. i-iv appears to help the condition, the dosage to be calculated according to the child's age. I have not seen belladonna do any good in the pulmonary complications of diphtheria. The question of stimulation arises here as in many other conditions associated with the acute fevers, and I believe that, as in whooping cough and measles, children suffering from broncho-pneumonia and

bronchial catarrh benefit greatly from either doses of 30 minims of whisky every 3 or 4 hours throughout the day or a larger dose of ℥ii-℥iv at night. The action of the alcohol is, I think, mainly sedative, and it is the safest hypnotic to give to a child whose heart is poisoned with the toxins of diphtheria. Opium is distinctly counter-indicated. If, when recovery has begun, the process of resolution is slow, the use of Ammonium Iodide in doses of from 2 to 5 grains three or four times in the day will often hasten matters.

Inflammation of the cervical glands should be dealt with by careful treatment of any septic condition of the throat or mouth, and by the application of dry cotton-wool to the neck. Should suppuration occur, the abscess must be opened and dressed with large moist dressings at least once a day.

If *nephritis* occur, the patient must be kept warm, special attention must be paid to the action of the skin and bowels, large quantities of fluid should be taken, and the use of the alkaline diuretics is to be recommended.

The treatment of *vomiting* is often troublesome. If it follows on cardiac failure, as it frequently does, its treatment must be mainly directed to the heart, but the application of hot fomentations to the epigastrium and the giving of small doses of champagne, frequently repeated, will sometimes help in getting rid of this most troublesome complication, but in association with cardiac failure it is always an ominous sign. Where it is due simply to the passage of food over the fauces, feeding with diluted or predigested milk by the nasal tube, if necessary for many days, has very frequently the effect of stopping the vomiting. Feeding with the nasal tube has the advantage over rectal alimentation in that the child's nutrition suffers less and there is no danger of the occurrence of scurvy should the process have to be continued over a long time.

The diphtheritic palsies are treated at first by rest and warmth. A severe palatal palsy will necessitate nasal feeding until recovery is sufficient to allow of swallowing without regurgitation of food into the naso-pharynx. Paralysis of a limb

is best treated, as general convalescence is established, by massage and mild galvanism. Small doses of strychnine, hypodermically or by the mouth, are recommended for all forms of diphtheritic palsy.

Epidemiology.—Diphtheria is endemic within the British Islands, and is liable to no very definite variations.

It may make its appearance in epidemic form as the result of a school or milk infection, or in connection with some insanitary spot like an unclean pigsty. It is always a moot point as to whether defective drainage has anything to do with the occurrence of diphtheria in a household, and I think that the result of the defective drainage may be looked upon as a strong predisposing cause, although perhaps not the immediate cause, of the disease, from its tendency to produce in the household a lowered vitality and general ill health with faucial inflammations of greater or less severity. It seems likely that the bacillus may remain potentially active in buildings and in soil for long periods, as is instanced by periodic outbreaks of diphtheria in certain hospital wards and in connection with the turning up of ground in the neighbourhood of dwelling houses. In schools it is easily conveyed from one child to another through the medium of slates, pencils, boots, games, and, among girls, of kissing. It is possible that infected clothing may remain dangerous for a long time.

Period of Infectivity. — The length of time during which a patient who has suffered from diphtheria may remain infectious is very variable. The bacillus has been found to be absent from the throat as early as the end of the second week. In view of the uncertainty which attends the recovery of the bacillus from the throat it is well to consider that all patients are infectious for at least six weeks, and no child should be allowed to return to school until eight weeks have elapsed from the beginning of treatment.

The *death rate* in diphtheria varies greatly according to the clinical type of the disease, the age of the patient, and the day of disease on which antitoxin has been given.

I append tables of death rates from the City of Glasgow Fever Hospitals showing the effect of treatment and age incidence on the mortality-rates.

Pre-antitoxin Years: 1871-1894.				Antitoxin Years: 1895-1909.		
Ages.	Cases.	Deaths.	Per cent. of Mortality	Cases.	Deaths.	Per cent. of Mortality
0-1	17	12	70·6	177	73	41·25
1-2	91	61	67·0	475	145	30·5
2-3	85	51	60·0	522	120	22·9
3-4	106	49	46·2	491	70	14·25
4-5	82	38	46·3	424	58	13·6
5-10	233	93	39·9	1127	106	9·4
10-20	93	9	9.6	391	17	4·3
20-30	66	6	9	198	5	2·5
30-	17	0	0	101	5	4·9
Total	790	319	40·4	3906	599	15·3

Home Prophylaxis. — Patients nursed at home must be rigidly isolated during the infectious period, and the room prepared in the usual way as a sick room. No patient may remain at home unless the house is of sufficient size to provide a room solely for himself and his attendant. It is well for the practitioner to inject all those of the household with a protective dose of antitoxic serum, say 300-500 units. The discomfort subsequent on this small dose is slight, as a rule, although, if care be not taken in diet and regulation of the bowels, "serum-disease" is fairly common, and, because of the neglect of simple precautions of this kind, "serum arthritis" occurs with greater frequency in persons who have received a protective injection than in those who have been injected for purposes of cure. It is remarkable how the injection of a small amount of antitoxic serum will prevent the spread of diphtheria in a household or in a school. After the recovery

of the patient disinfection must be thorough, and during his illness everything which comes in contact with him must be steeped in disinfectant and boiled before coming in contact with others.

Public Health Administration.—In every case where the accommodation at home is not adequate for suitable isolation, the patient must be removed to Hospital. The Local Authority should provide means for the examination by a competent person of swabs from suspected throats, and should supply sterile swabs for the use of the practitioner. The question of the supply of antitoxin gratis or at a reduced price is an important one, as many people cannot afford to bear the cost of serum-treatment, even though their houses are quite suitable for the nursing of diphtheria. In some districts this is done, but the practice is not yet general. Similarly, the protective injection with 300-500 units of antitoxic serum of all children in a school when one or two cases have occurred should be undertaken. The drains of a house or school where diphtheria has appeared must be carefully tested, and put right if found to be defective, and schoolrooms as well as living-rooms should be stripped of paper, sprayed with formalin solution and repapered or whitewashed. The milk supply of a household where diphtheria has appeared must be carefully investigated. All bedding and clothing which has been in contact with the patient should be steamed, and more perishable furniture and books treated with formalin spray or vapour.

Chapter IV.

THE PLAGUE.

Synonyms.—Bubonic Plague: Pestis Bubonica.
Fr.: La Peste.
Ger.: Die Pest: Bubonpest.

Definition.— An acute infectious fever associated with enlargement of glands from which, as well as from the blood stream and viscera, the causal organism may be recovered—the B. Pestis, discovered, independently, in 1894 by both Kitasato and Yersin.

Incubation Period. — This varies from a few hours to about a fortnight, but the usual period is from three to eight days.

Rash. — There is no typical rash in plague as in typhus or scarlet fever, but hæmorrhagic areas varying from small pin-head petechiæ to blotches about half-an-inch in diameter are frequently found on the skin over the body, especially on the more exposed parts. During the period of invasion and early stage of fever the skin is usually flushed and dusky and may show a peculiar sub-cuticular mottling such as is seen as a prodromal eruption in typhus and measles.

Period of Invasion.—The symptoms of invasion last for a very varying period according to the malignity of the attack. In certain cases there may precede the stage of fever a day or two of severe headache, malaise, slight shivering, aching in the limbs, vertigo and great weariness, with sometimes drowsiness and sometimes vigilance and evil dreams, and during this time the temperature may be normal or only

very slightly raised. In other cases the disease is ushered in by vomiting, violent headache, considerable shivering, and sometimes diarrhœa, with sudden and rapid rise of temperature in a few hours to highly febrile registers, 103° to 106° F. being frequently observed. The rise of temperature is not commonly quite so sudden as in malaria, but is more comparable with typhus.

Stage of Fever.—The pulse and respiration are greatly increased in rate.

The face, in white-skinned persons, is of a dusky pallor, and looks dull and heavy, as in typhus, but added to this there is a curious anxious expression about the eyes, which is accentuated when the patient is touched. The eyes are blood-shot, and the skin is dry and burning. The tongue is covered with a thick creamy fur which rapidly becomes brown, and sordes form on the lips and teeth. Prostration is extreme and the voice is feeble. The patient may suffer from delirium, usually of a low muttering type, but sometimes violent, or he may, as is more common, sink rapidly into a typhoid state of stupor and prostration, with picking at the bedclothes, *subsultus tendinum*, and retention of urine. Vomiting frequently occurs, and either diarrhœa or constipation may be present. The pulse, which for the first few hours may have been full and bounding, becomes soft and intermittent, and the first sound of the heart is weak and almost inaudible. The spleen is enlarged and frequently the liver also. The urine is scanty and high coloured and may contain a small quantity of albumin, but anything in the nature of an acute nephritis is rarely met with.

Clinical Types.—The severity and duration of the disease vary very much in different epidemics even in the East, and an epidemic of plague in Western and Northern Europe differs greatly from that met with in the warmer climates and the unhygienic surroundings of the native quarters of towns and villages in China, India and Southern America. Among white races living in sanitary dwellings in a temperate climate, plague tends to be less virulent and more chronic in its course than is usual in sub-tropical countries,

and the danger of a large epidemic is slight since the winter and spring are too cold to favour the activity of the B. pestis which has, besides, no such nidus of filth as is met with in any Eastern town. But the difference is merely one of degree—plague in Western Europe or in the United States of America is simply plague in Hong Kong watered down—the manifestations are the same, though less severe, and the clinical types are identical. The tendency to chronicity was notable in the Glasgow epidemic, when crisis occurred in one case 18 days after the onset of the disease, and when two of the ultimately fatal cases survived, one to the 40th and another to the 44th day.

In nine-tenths of all cases of plague the type is bubonic, *i.e.*, in addition to the conditions described above as belonging to the "stage of fever," visible swelling and inflammation of one or another of the more superficial groups of lymphatic glands occur, forming the typical "bubo." The buboes are most often single, and appear in one groin in a large percentage of cases, but they may appear on both sides. They may also appear in the axilla, and, chiefly in children, at the lower angle of the jaw. Small buboes have been seen in the root of the neck, the sub-occipital region, and in the bend of the elbow, but buboes in these situations are extremely uncommon. The buboes vary very much in size, from a hazelnut to the size of one's fist. They are usually reddened on the surface, painful, tender on manipulation, and are often surrounded by a brawny area of infiltration both of skin and connective tissue. The bubo makes its appearance at some time between the first and fifth day of the stage of fever, most commonly during the first day.

In favourable cases after a very variable period of fever the symptoms begin to abate and the first indication of betterment may be the occurrence of a profuse sweating. The temperature begins to fall, the pulse to recover its tone, the tongue to clean, and the patient becomes sensible and intelligent. But the bubo does not subside with the other symptoms. In most instances it softens and suppurates, and, if left to itself discharges through a necrosed area of skin a quantity of very foul smelling pus mixed with sloughs. When

it does not suppurate it may take months to disappear. The healing of a burst or incised bubo is a very tedious process and may prolong convalescence for many weeks. In a small minority of cases convalescence is rapid. If death occurs, it does so usually within the first week of the disease, from heart failure, profound asthenia, and coma, sometimes with convulsions. But in some cases life is prolonged past the subsidence of the more acute manifestations of the disease, and death may occur from asthenia after prolonged suppuration of one or more buboes.

The other clinical types usually recognised are the *septicæmic* and *pneumonic* forms of the disease.

In the typical *septicæmic* form no enlargement of lymphatic glands is visible during life, and the signs of illness are fever, very often slight, profound exhaustion, delirium, stupor and coma, with, in a fair number of cases, hæmorrhages into the skin and from the bowels or other mucous membranes. In these cases the bacilli are found in large numbers in the blood. Diarrhœa is a common feature in the septicæmic form of plague, and an intestinal form of the disease is sometimes described. There is little doubt but that the first cases, which were unrecognised, occurring in the Glasgow epidemic of 1900 belonged to this intestinal variety of the septicæmic form. Death usually occurs in septicæmic plague between the first and third day of the disease, and this form is very dangerous to the community, as unless it occurs in the middle of an epidemic it is seldom recognised as plague, until the occurrence of attacks of the bubonic form among those who have been in contact with the patient makes it plain what his illness has been.

There is, however, a somewhat modified form of the septicæmic type which appears particularly in temperate countries and in which, while the bacilli are found in the bloodstream, the attack is characterised by slight enlargement of the superficial lymphatic glands, so that small masses of glands may be seen in the groin, axillæ and neck. In this class of case the small buboes are always multiple. The mortality in this somewhat modified form of the septicæmic type

is rather less than in that which shows no lymphatic enlargement, but is far in excess of the death-rate from the true bubonic variety.

Pneumonic plague is the most directly infectious of all the forms of plague, as the bacilli are discharged in great numbers in the sputum, and it is also an extremely fatal form of the disease, death occurring usually between the third and fifth day of illness.

The symptoms of invasion are severe and the temperature rises rapidly to high registers. The patient is short of breath, and troubled by a frequent cough and profuse rather watery blood-stained sputum, not viscid and "rusty" like the sputum in an ordinary acute pneumonia. Signs of consolidation of the lung are not well marked, but there may be some dullness on percussion at one or both bases behind, with great diminution of the volume of the respiratory murmur and much intra-pulmonary crepitus. Respiration is very rapid. As in the septicæmic form there is great danger to the community in such cases when they occur at the beginning of an epidemic, since there is little to indicate clinically that they are anything more than extremely malignant cases of acute pneumonia, and the infection may thus be spread widely before the disease is recognised as plague.

Another form which often appears at the beginning or end of an epidemic of true plague, but which has been noted as occurring in great numbers in the course of certain epidemics, is the *pestis minor*, or *ambulatory form* of plague. It is characterised by slight malaise, headache, a little fever, and the occurrence of small buboes which do not suppurate. It is easily seen how such cases may spread the disease, and their recognition is of the greatest importance.

Diagnosis. — The only reliable method of diagnosis is by the recovery of the infecting organism from the bubo, the blood, the stools, or the sputum. Nothing but a bacteriological examination can separate plague from adenitis of other kinds associated with fever, when they occur in a district where plague is common or in the course of an epidemic.

It will be necessary to differentiate bubonic swellings of all kinds, whether cervical, axillary or inguinal, when plague is epidemic, and cases of tuberculous adenitis, pyogenic infection of glands and venereal bubo will all be suspected. The puncture of a bubo and the withdrawal of some of the fluid by a syringe with due antiseptic precautions, and the examination of the fluid by staining or culture, is the only method by which plague can be accurately detected. Fortunately the bacillus pestis is large and stains well with the ordinary anilin stains, such as Gentian Violet, and it is usually easily recognised from a stained smear-preparation made directly from a bubo. The short thick bacilli, staining with a "cap" at either pole with a clear space between, present a very typical appearance. A culture on peptone-agar should be made at the same time and incubated at 37° C. for 18 hours, but it is to be remarked that in cases which have been ill for some time before examination, especially when the bubo is beginning to soften, a somewhat degenerated and badly-staining organism may be seen in a smear-preparation, but a culture may be sterile. When any doubt remains after examination by culture and staining, inoculation of a rat should be performed.

The differential diagnosis of plague, apart from the occurrence of bubonic swellings, is clinically impossible without bacteriological examination. In temperate climates it may be confused with typhus, which is the only one of our common infectious fevers to which it bears any resemblance, unless the type be "intestinal" or "pneumonic." In the Glasgow epidemic of 1900, the early cases which were not sent to the Fever Hospital were "intestinal" in type and were labelled "Zymotic enteritis," while the first three which were brought to Hospital were certified "Enteric (?)" and had well marked buboes. In Suffolk, during the autumn of 1910, the first cases were pneumonic in type and were, most naturally, not recognised as other than a very virulent pneumonia. It is most unlikely that a severe case of bubonic plague will be mistaken for anything else, but a mild case with bubo in the groin can only be distinguished from a venereal bubo by the discovery of the B. pestis.

Complications.—The complications of plague are not at all numerous. Those which do occur are usually in association with pyogenic infections, resulting from the suppuration of the bubo, such as metastatic abscesses and pleurisy.

In the Glasgow epidemic of 1900 we observed one case with an axillary bubo where death resulted after the formation of a large abscess under the pectoral muscle from which we recovered the pneumococcus.

Sequelae.—Beyond a prolonged and troublesome convalescence with much anæmia and muscular weakness, the sequelæ of plague are unimportant.

Treatment.—The treatment of plague apart from the use of antitoxic serum consists mainly in the maintenance of strength by rest and judicious stimulation with alcohol and strychnine and the procuring of sleep and relief from pain by the use of small doses of opium, either hypodermically in doses of $\frac{1}{6}$ gr. of morphine, or by the mouth in the form of Battley's solution in doses of 5 min. every two or three hours until quiet is induced. The bubo must be carefully tended; the skin over it should be gently cleansed with soap and water, sponged with spirit each day, and covered with a layer of Gamgee's tissue after powdering. When softening occurs and a necrotic area of skin appears, it is well to open the swelling freely to allow of sufficient drainage, and a discharging bubo must be dressed with the strictest antiseptic precautions.

Antitoxic Serum has been prepared by Yersin, Calmette and Borrel, but the effectiveness of these has not been proved in India and China, except when Yersin's serum was first used in Hong Kong. On that occasion twenty-four out of twenty-six treated cases recovered.

It is possible, however, that in temperate climates antitoxic serum may prove effective, if a more powerful and properly standardised serum is prepared. Apart from serum treatment one feels very powerless in the presence of a disease so virulent and rapid in its course as plague, and all other

treatment is frankly palliative and unsatisfactory. Our cases in Glasgow were too few to make our observations on the effect of serumtherapy of much value, but our impression was that in cases where we had a little time afforded us it was an aid to recovery, and that after the use of Yersin's serum the patients rallied somewhat and were more comfortable, the most reliable happenings being that the pain of the bubo became less and profuse sweating often followed the injection. The best results undoubtedly followed the giving of 40 ccm. of serum intravenously, and this dose may probably be increased with advantage.

Epidemiology.—Plague is endemic in India, China and Uganda. It has appeared in epidemic form in Russia, Egypt, Turkestan, Japan, the Philippines, Madagascar, South Africa, South America, San Francisco, and Australia. With the exception of the limited epidemics at Oporto in 1899, Glasgow in 1900 and 1901, and Suffolk in 1910, plague has not appeared in Western Europe for long, save for the occurrence of a few cases here and there, mostly imported, in the great seaport towns. On the whole, plague is favoured by a temperature that is neither extremely hot nor extremely cold. In Arabia, epidemics tend to decline during the hot and dry summer, and in temperate climates the disease usually dies down in the winter, to reappear, may be, late in the following summer. In Glasgow, the disease appeared both in 1900 and in 1901 during the month of August. On the other hand, the plague has raged through the extreme heat of a Hong Kong summer, and has survived the rigours of a Russian winter.

Method of Infection.—While undoubtedly directly infectious, plague is not nearly so much so as scarlet fever, measles, or smallpox, and it is extremely rare that the attendants in a clean and well-ventilated hospital acquire the disease from the patients unless they are dealing with the pneumonic variety. Unfortunately cases of laboratory infection have, however, been known both abroad and in England. Where attendants on the sick have contracted the disease, it has usually been when they have visited the patients in squalid and verminous homes, or when the patients have been

allowed to wear their dirty and probably flea-infested clothing in hospital, or when the attendants have been careless about abrasions and cuts on their own hands or faces. Apart from contact with infected bedding, clothing or furniture, where from the collection of filth the virus has been unusually concentrated, it seems beyond doubt, after the work done by Lamb at Kassauli, that plague is spread from patient to patient by means of fleas and other vermin, and the disease is carried on by rats and spreads from them to human beings, once more by the agency of fleas. It has been remarked in the East that plague among rats has preceded an epidemic among human beings, and that the surviving rats will leave a district in which other rats have died in great numbers from the disease, some of them doubtless carrying infection with them. In temperate climates at the present day, plague must be imported from some place where it is either endemic or epidemic at the time, but the mode of entry of the disease is not always plain. The two small outbreaks in Glasgow in 1900 and 1901 are of extreme interest, because no definite case of plague was imported at the beginning of the first outbreak, nor were any of the patients known to have been in direct contact with foreign shipping. The disease arose in a squalid part of the town from no definite source of infection, as it might do in any other large city, despite all the precautions of modern health administration. The second outbreak in the following year arose in the largest Hotel in the city and was traced readily to rats who frequented an old disused sewer. The rats were found to have plague amongst them to a very considerable extent, and it is likely that the rats were first infected during the epidemic of the previous year, while that first epidemic may well have been due to rats infected with plague by other rats who had come from abroad on board ship.

Period of Infectivity.—While in a few cases the B. pestis has been found to have disappeared from patients after the lapse of a fortnight from the commencement of the illness, it has been found in others as late as the fifth or sixth week. It is, therefore, wise to consider that patients who have had plague are infectious for at least six weeks, and they should be isolated for that period.

Death Rate.—The death-rate varies greatly in different epidemics, even in the East, and while one epidemic may show a death-rate of 90 per cent. among those attacked, another may show a death-rate of only 50 per cent. It is astonishing to note the effect of nationality on death-rate in the East. Manson quotes in this connection the figures of an epidemic in Hong Kong in which, while "the mortality among the indifferently fed, overcrowded, unwashed and almost unnursed Chinese amounted to 93.4 per cent., it was only 77 per cent. among the Indians, 60 per cent. among the Japanese and 18·2 per cent. among the Europeans, a gradation in general correspondence with the social and hygienic conditions of these different nationalities." In the Glasgow epidemic of 1900, when plague appeared among the lowest of the Irish population, the hospital death-rate was 28·5 per cent., while the death-rate among all cases at home and in hospital was rather over 40 per cent.

Personal Prophylaxis.—As no patient suffering from plague can be treated at home with any safety to the community, the question of "home prophylaxis" does not arise. But something falls to be said about the precautions to be taken by those whose work it is to tend the patients, to investigate suspicious cases and to work in the infected area. Nurses and physicians must hang over the patients as little as possible, and must take the greatest care to protect any cut or abrasion of the skin with an impervious dressing of collodion or "New-skin." The hands should be washed very frequently, particular care being taken with regard to the cleanliness of the nails, and after washing, the hands should be immersed for a few minutes in a fairly strong solution of permanganate of potash. Stronger antiseptics are not desirable as they encourage the formation of cracks in the skin, and expose the attendant to the risk of infection through an injured epidermis. The nurse should see that the patient, if verminous, is freed as soon as possible from his parasites, since infection by them is a dangerous possibility. No food must be eaten in the ward, and frequent bathing and changing of garments is essential.

Those who are engaged in work in an infected district, either as physicians, inspectors, or on the disinfecting staff, ought to wear leggings, as the legs below the knee are the most easily accessible portions of the body to fleas, and the hands should be washed frequently as in hospital. Rat-catchers should wear gauntlets.

Public Health Administration.—In dealing with plague, as with smallpox, it is necessary not only to isolate all persons who have fallen victims to the disease, but to segregate carefully all "contacts" until the maximum incubation-period of a fortnight has elapsed. In Glasgow, the patients were taken to the Fever Hospital, and all the "contacts" were isolated in Reception Houses where they were under constant supervision by a trained staff of nurses and visited twice daily by a physician. Their temperature was recorded night and morning, and the slightest variation from normal health was reported by the nurse to the visiting physician at any time of the day. I may take the administration methods of the Glasgow Sanitary Office, carried out under the supervision of Dr. A. K. Chalmers, as being applicable to any western country attacked by plague, and, instead of stating what ought to be done, I shall state what was done in 1900 as being as effective as possible.

The following routine was followed during the epidemic:

1. Within the infected area ashpits were emptied thrice weekly and washed once a week with chloride of lime solution.
2. Back courts were hosed every night with chloride of lime solution.
3. A special inspection of the district was undertaken for the detection of dirty houses, entries, &c., and for the overcrowding of houses.
4. Medical inspection of the district was carried out and the inhabitants of infected buildings and all "contacts" were offered injection with Yersin's serum or Haffkine's vaccine, while all suspected cases were visited with their own medical attendants.

5. Handbills were distributed offering the service of the medical staff at any time.
6. The crews of all ships were inspected on arrival in port.
7. Fumigation of infected houses was carried out by liquified SO_2 for twelve or twenty-four hours, after which the house was entered and all articles of bedding, clothing, &c., were wetted with a 2 per cent. solution of formalin (1 gallon of a 40 per cent. solution of formaldehyde to 50 gallons of water), removed to the Sanitary Wash-house, and then boiled or steamed. All articles which could not be boiled or steamed were burned.
8. All houses where cases had occurred or from which contacts were removed were sprayed with the formalin solution, as were also the lobbies and entries.
9. Clinical demonstrations were given daily to medical practitioners at the hospital.
10. A pamphlet descriptive of the varieties of the disease was distributed among the medical practitioners of the city.
11. Physicians to out-patients at the various hospitals were specially circularised.
12. A campaign against rats was entered upon; rat-catchers were engaged and the bodies of rats were investigated for the signs of plague. The sewers of the hospital were treated with liquified SO_2, and the rats driven from the hospital by this method.
13. The bodies of those who died from plague were drenched with formalin and enclosed in an air-tight leaden shell before burial.
14. As the epidemic arose among the Irish Catholic population, the holding of wakes over any dead bodies was prohibited, thus repeating one of the old precautions taken at the time of the great ravages of the plague in Glasgow in 1646, when it was ordained "that ther be na meiting at lykwakes nor efter burrials, and that this be intimat by touk of drume."

Chapter V.

CHOLERA.

Synonyms.—Cholera morbus, Asiatic Cholera, Epidemic Cholera.

Fr.: Choléra.

Ger.: Cholera.

Definition. — An acute specific disease, characterised by violent gastro-intestinal symptoms, propagated by water, running a short course and occurring in epidemics, associated with an organism found in the stools, the Cholera Vibrio, or Comma bacillus, discovered by Koch in 1883.

Incubation Period.—This varies from a few hours to ten days, and three to six days is given as the usual incubation period.

Rash.— No rash has been observed as typical of the disease, but a patchy scarlatiniform eruption is occasionally seen during the stage of reaction.

Clinical Types. — Cholera may attack a patient with great suddenness, or may be preceded by certain prodromal symptoms. The most common of these is the "premonitory diarrhœa," but it is open to doubt whether this is really due to the cholera infection, or whether it is not due to a simple intestinal catarrh which renders the bowel more vulnerable to the attack of the cholera germ. Occasionally a short period of languor and depression with headache and noises in the ears, precedes the true onset of the disease. The first symptom of cholera is the passage of very frequent, copious, watery stools, which is not accompanied by any pain or griping. The stools very quickly lose their fæcal character

and take on the "rice-water" appearance so typical of the disease, *i.e.*, they are like very thin rice-water containing abundant small white flakes. Violent vomiting soon appears, at first of food taken and bile-stained mucous material, but very quickly of the same "rice-water" material as is passed by the bowel. The patient now presents all the appearance of profound collapse—he looks shrunken and pinched, the eyes are sunken and the fingers look shrivelled, while the skin generally is cold and covered with a clammy sweat, respiration is rapid and shallow and the pulse is weak and fluttering or may be altogether absent. The urine is completely suppressed. The temperature in the axilla and mouth is subnormal, sometimes as low as 93° or 94° F., but at the same time the rectal temperature may be as high as 104° F. The patient is restless, complains of intense thirst, and suffers excruciatingly from cramps in the abdomen and extremities. His mind may be clear although apathetic, or he may sink rapidly into a mild delirium followed by coma. This stage has been called the "stage of collapse" or "algide stage," and may terminate in death, in rapid convalescence, or in the stage of "febrile reaction."

When death occurs in the stage of collapse, it usually does so within twenty-four hours of the onset of symptoms, and may occur after an illness of only two or three hours.

Sometimes after the stage of collapse having lasted for about a day, the purging gradually ceases, the body becomes warm again, the pulse is stronger, the urinary flow returns, bile appears in the motions, and in a few days the patient is well again. Much more commonly, however, the "algide stage" merges into the "stage of reaction." As this stage is entered upon, the patient becomes warmer, the shrivelled, shrunken look disappears, he grows less restless, ceases to suffer pain, and the pulse grows stronger, while the bowels move less frequently, and the motions begin to show bile-staining. At the same time a certain amount of fever makes its appearance, of variable degree, rarely rising to very high registers. In some cases this "febrile reaction" lasts only for a few hours, at the end of which the fever subsides and convalescence begins. But in more severe cases the stage of

reaction may last for four or five days to rather over a fortnight, during which the patient may be highly febrile and resemble a case of enteric fever, the resemblance having struck some observers so much that the name "cholera typhoid" has been given to this stage of the disease. The patient's face is flushed, and the fever may rise even to hyperpyretic registers. The tongue is brown and dry, low delirium, with some tremor, and *subsultus tendinum* may be present, or the patient may sink into a state of profound stupor. The stools are like the later stools in enteric fever, greenish or "pea-soup" in character, containing, perhaps, a little blood, and are commonly very offensive. The urine may remain suppressed for some days, even as long as six, and when the flow is re-established it is usually scanty, high-coloured and may be highly albuminous, containing abundant casts. In favourable cases the symptoms gradually subside in about a week, the urine becomes copious and less albuminous, and the patient becomes convalescent. In cases which prove fatal during this period, death often results from a profound asthenia or a low form of pneumonia. Diarrhœa may again become urgent, and the patient may die with all the indications of a very acute enteritis. Death may also occur after convulsions, or profound coma, which usually occur when there has been delay in the re-establishment of the urinary flow, or when the urine has remained very scanty and albuminous.

Cholera sicca is the name which has been given to a very fatal class of case in which collapse sets in with great rapidity and in which there is almost no diarrhœa or vomiting, and no passage of "rice-water" stools. In such cases *post-mortem* examination reveals the presence of large quantities of rice-water material in the bowel, although none has been passed during life.

Mild forms of Cholera.—In all epidemics mild cases are found, in which there is diarrhœa and malaise without complete suppression of urine or the occurrence of "rice-water" stools, and in which the diarrhœa is not accompanied by cramps. In other cases the typical rice-water stools may be present, but are not accompanied by suppression of urine,

while the cramps may be not at all severe. In these mild forms the attack subsides quickly, and is not followed by any "stage of re-action."

Relapse in Cholera.—In a certain number of cases after the patient begins to show signs of "reaction" a relapse occurs, and the patient sinks again into a state of collapse and purging. Such relapses are generally fatal.

Diagnosis.— The diagnosis of cholera, especially at the beginning of an epidemic, is not always an easy matter. Fungus-poisoning, ptomaine-poisoning, zymotic enteritis, and the early stage of trichinosis, may present symptoms extremely like Asiatic cholera, and may occur in more or less epidemic form. These diseases are accompanied by diarrhœa and vomiting, with a tendency to collapse, and the stools may resemble very closely the "rice-water" evacuations. It is very unusual, however, that the stools are as deficient in bile as in a severe case of cholera, and "rice-water" vomiting is never seen in other diseases, while in fungus-poisoning portions of the fungus eaten may be seen in the stools, and microscopic examination of the dejecta in a case of trichinosis will reveal the presence of the adult worm. The great difficulty in differential diagnosis in temperate climates is between zymotic enteritis or acute gastro-enteritis and cholera, and here we must depend largely on the results of a bacteriological examination of the dejecta. Films may be made directly from the stools, but it is best to make cultures from one of the flakes floating in the liquid stool. After placing such a flake in a test tube of Dunham's solution of 1 per cent. peptone and ·50 per cent. sodium chloride, and incubating for some 6-10 hours at 37° C., the upper strata of the fluid will be found, in most cases of cholera, to show an abundant growth of the characteristic vibrio, or comma bacillus.

But, as the bacillus of Finkler and Prior and Deneke's vibrio are morphologically practically identical with the vibrio of cholera, it will be necessary in addition to try to get the "cholera-red" reaction, which is obtained by adding a few drops of sulphuric acid directly to the culture. In view of the necessity for accurate differentiation of the cholera vibrio, it is wise to leave the bacteriological examination in

the hands of a skilled bacteriologist, although it is a good thing for the practitioner to make a film from the suspected dejecta and search directly for the vibrio after staining with fuchsin. The presence of any vibrio in the dejecta makes it necessary to have a further examination made. It is to be remembered that in a few cases of cholera the vibrio may not be discovered, just as in a certain number of cases of pulmonary phthisis careful search has failed to reveal the presence of the bacillus of tubercle in the sputum during life, so that the negative result of a bacteriological examination must not be taken absolutely to mean that a patient does not suffer from cholera.

Complications.—The complications of cholera are not numerous, but may be severe. Occasionally during the second week pneumonia, bronchitis or pleurisy occurs, or some sloughing of the fauces, bladder, or sexual organs, or, it may be, actual gangrene of fingers, toes, ears or nose takes place, while bed-sores are apt to occur. A troublesome complication is ulcer of the cornea, which may occur early in the "stage of reaction." The lower part of the cornea is that which is usually affected, and the beginning of the process is characterised by a cloudy opacity in the cornea, covered, perhaps, with some exuded lymph. Ulceration quickly follows, and perforation may result, and as a rule, if the patient recovers, the eye is destroyed. Sometimes during the second or third week an acute suppurative parotitis occurs which seriously interferes with the patient's taking food, and is always an ominous sign.

Sequelæ.—The common sequelæ of cholera are anæmia, mental and physical weakness, insomnia, enteritis, colitis, and nephritis. In most cases which have recovered after passing through a severe "stage of reaction" convalescence is protracted and many months may elapse before the patient recovers his ordinary strength.

Treatment.—So far, as the death-rate shows, the treatment of cholera has been most unsatisfactory. It is purely symptomatic, as no anti-cholera serum or vaccine has been discovered for curative purposes. In the stage of

premonitory diarrhœa, or very early in the stage of "rice-water" purging, opium, given as laudanum or chlorodyne in large doses combined with brandy, is often very efficacious in checking the loss of fluid, and even in the "stage of collapse" the use of morphine hypodermically in doses of $\frac{1}{6}$-$\frac{1}{4}$ of a grain is not to be discouraged. But where the "stage of collapse" or "algide stage" is fully established, the treatment first recommended by Cox of Woosung, and modified by Leonard Rogers of Calcutta, is worthy of serious trial. In view of the fact that many of the most dangerous symptoms in cholera are due to the loss of fluid by the bowel, Cox recommended the continuous slow intravenous injection of normal saline solution, allowing the fluid to flow by gravity from a vessel placed about a couple of feet above the level of the point of injection, continuing the process so long as any danger of collapse was present.

Leonard Rogers published his results of intravenous saline injections in the British Medical Journal of Sept. 24th, 1910. He uses a "hypertonic" saline solution, consisting of 120 grains of sodium chloride, 6 grains of potassium chloride and 4 grains of calcium chloride to a pint of sterile water. Soluble tablets for the making of this solution may be obtained from both Messrs. Burroughs, Wellcome and Co., and Parke, Davis and Co. Where the rectal temperature is hyperpyretic the solution should be injected at a temperature not exceeding 98·4°, or even somewhat lower. When collapse is marked, three or four pints may be given at the rate of four ounces per minute, and the rate should be slowed to one ounce per minute if the patient complains of headache or other distress. The specific gravity of the blood should be taken before the commencement of this treatment, as the amount of fluid injected ought to be regulated by the height of the specific gravity, as collapse, simulating cholera, but without a high specific gravity of the blood, will not be helped by intravenous injections, but the reverse. Rogers found that his results with intravenous injections were better than with intracellular and rectal injections, but has found that he has obtained his best results by a combination of intravenous "hypertonic" injections and the giving of permanganates by

the mouth. He gives permanganate of calcium in solution, ($\frac{1}{2}$-1 grain to the pint of water, increased rapidly by 4-6 grains to the pint) and encourages the patient to drink as much as possible in the day. Vomiting is seldom induced by this treatment and, indeed, is often checked by it. In other cases he has given the permanganate of potash in doses of 2 grains in the form of a pill made up with as little kaolin and vaseline as possible and coated with a varnish composed of one part of Salol and five parts of Sandarach varnish. The pills must be absolutely fresh. One pill should be given every quarter of an hour for the first two hours, and then every half hour until the stools are green and less copious, which, Rogers states, occurs in about twelve hours. At the beginning of the second day eight more pills should be given with the same intervals, and, in severe cases, eight more at the beginning of the third day, to prevent relapse. Barley water may be given to the patient during treatment with the permanganate pills.

Vomiting may be relieved by sips of iced water or small quantities of iced champagne. The cramps can often be alleviated by friction by the hand with some A.B.C. Liniment or other mild rubefacient, or, if unrelieved by such treatment, may demand the hypodermic injection of morphine, or even the inhalation of chloroform. The patient must be kept warm and absolutely at rest; the use of a warmed bed pan must be insisted on, since the exertion of rising to go to stool is most dangerous.

Calomel in small doses, as in enteric fever, has been recommended by some, and the whole gamut of astringents has been tried, but it is plain that in large numbers of cases of cholera vomiting prevents the employment of either oral medication or alimentation. In the same way the profuse diarrhœa makes any attempt at rectal medication equally impossible, so that hypodermic, intracellular, and intravenous methods will be found in many instances to be the only ones possible.

If the pulse fail at the wrist, the hypodermic injection of alcohol or ether may spur it on for a little, and a single intravenous or intracellular injection of a pint of saline solution

may bring temporary improvement, but if the saline injections are to be effective they ought to be given slowly and continuously and not intermittently, and it is better to try to prevent the occurrence of serious cardiac failure by beginning such injections early in the disease than to institute them when failure of the heart has begun already to render absorption even from the lymph-spaces extremely slow and difficult.

If the urine be suppressed after the first day of the stage of reaction, it is well to stimulate its secretion by hot applications to the loins, or by the application of dry cups to the lumbar region followed by a hot poultice or fomentation. Careful examination should be made for distended bladder, as sometimes after a period of suppression of urine it is retained by an atonic and insensitive bladder after the re-establishment of secretion. Should the bladder be found distended, the catheter should be used at once.

If in the stage of reaction there should still be much purging, large doses of the salicylate of bismuth should be given with a little powdered opium. The rectal injection of large quantities of tannin in mucilage is sometimes of service in obstinate diarrhœa, and, as in enteric fever, the careful irrigation of the lower bowel with hot water, using a soft tube, may cure the condition. Should the patient be constipated, no purgatives should be given, but movement of the bowels should be secured by the rectal injection of soap and water.

When corneal ulcer occurs, the eye should be bathed frequently with warm soda-bicarbonate solution or treated with some of the albuminous salts of silver, while touching the edge of the ulcer with the galvano-cautery may stay the process.

Sloughing of the fauces should be treated by careful spraying of the throat with some mild antiseptic, and sloughing of the bladder by rest and bland diuretics in combination with small doses of tincture of belladonna, 1 or 2 minims, every hour. Gangrene and parotitis fall to be dealt with surgically. The treatment during convalescence is mainly dietetic, but persistent anæmia will be helped by the use of iron and arsenic, nervous symptoms by rest and change of

scene and the use of the bromides combined with belladonna and nux vomica, while enterocolitis may be relieved by a bland dietary or the giving of powdered ipecacuanha with very small doses of calomel and regular irrigation of the lower bowel. The treatment of nephritis is too well known to need comment.

Diet.—During the algide stage, all food should be withheld. Thirst may be quenched by sips of iced water if vomiting is not induced by small quantities of fluid taken by the mouth, but the use of saline by continuous intravenous or intracellular injections will be found to quench thirst almost as well as sips of water by the mouth, and insures at the same time a replacing of some, at least, of the fluid lost by the bowel. During the "stage of reaction" and in "cholera typhoid" the diet must be fluid and extremely bland. Milk diluted with barley-water or rice-water, with a little clear soup or meat-juice, should form the entire diet of the patient during these periods, since errors in diet may induce relapse, or at least a very troublesome diarrhœa. During the establishment of convalescence a mixed diet should be quite as carefully resumed as in enteric fever, and, indeed, the resumption may be with advantage even more gradual, as the future health of the intestine depends largely on careful feeding during convalescence.

Epidemiology.—As a rule cholera appears in temperate climates during the summer months and disappears as winter advances, but it has been known to survive the cold of a Russian winter. In Europe the later epidemics have been definitely spread by water-supply, as is instanced by the epidemic in Hamburg in 1892-93, and the Naples epidemic of 1883. The danger of an impure water-supply was very well exemplified in the Hamburg epidemic. Hamburg and Altona are practically one town (in one part the boundary between the two is simply a street), but at the time of the epidemic Hamburg was more or less an independent town, while Altona was Prussian. Both drew their water-supply from the Elbe, but, while Altona had an elaborate system of filter beds, Hamburg had none, and the water was pumped

straight into the main from the river. The result was that Hamburg suffered severely, while the cases in Altona were few, showing that the disease was definitely water-borne, since the communication between the two towns both commercially and socially is considerable, and, had the disease been communicated chiefly by contact and aerial convection like small-pox, the two towns would not have suffered so disproportionately. The causal agent is in the stools, and patients may of course, infect those surrounding them by the dejecta, and defective drainage may spread the disease through a limited area, but when the water supply is good and free from all risk of contamination, it is not probable that an epidemic will attain any very great proportions. There is no doubt that the cholera vibrio is at least a necessary adjunct to the acquirement of the disease, but from laboratory experiments it has been shown that large quantities of the vibrio in culture may be swallowed with impunity. But the laboratory pure culture may be a very different thing to the bacillus in the ground, and we do not know what symbiotic influence may be required for the acquirement of a virulence necessary for the production of an epidemic. That such a virulence must be acquired outside the body is shown by the fact that at the beginning of an epidemic the cases tend to be acute, short and fatal, while as the epidemic proceeds the attacks tend to be milder and of longer duration. Among the causes which contribute to an attack of cholera must be mentioned chill, irregular living, errors in diet, and fear. The last is no mere fiction of the imagination. I have heard the same story repeatedly from men who have seen service in the East, both physicians and others, that, in their experience, fear is one of the most powerful predisposing causes of an attack of cholera, and when it is remembered how fear and worry tend to lower vitality, it is not surprising that this should be the case.

Period of Infectivity. — The discharges of a patient who has had cholera may remain infectious up to about seven weeks from the onset of the illness, although in mild cases they may be free from the vibrio in two or three weeks, and it is wise to consider a patient infectious until the vibrio can be no longer discovered in the stools.

Death-Rate.—The average death-rate in all epidemics is calculated at about 50 per cent. of cases attacked, but it is much higher in some epidemics, while in others it is considerably less. Much depends on the condition of those attacked. The old, the very young, pregnant women, those who suffer from disease of the heart, liver or kidneys, the naturally feeble, the poorly fed, and the alcoholic, die in great numbers.

Personal Prophylaxis.—As in plague, no patient ought, in civilised western countries, to be nursed at home, whatever be his social position, so that discussion of "home prophylaxis" does not fall to be made. Those in attendance on the sick should take the same precautions as in enteric fever, and the same scrupulous care should be adopted in the disinfection of the dejecta, vomited material, and all vessels and clothing which have been in contact with the patient. Food must never be eaten in the ward, and the hands should be most carefully cleaned after touching the patient. Those living in a district in which cholera has appeared should pay the strictest attention to personal and household cleanliness, and must live most carefully in every way. Fruit and cucumber which has travelled at all should not be eaten, as the possibility of "carried" fruit causing diarrhœa is well known, and anything which encourages gastro-intestinal catarrh predisposes to cholera. The domestic water-supply must be enquired into, and it is better during an epidemic of cholera to drink no fluid which has not been thoroughly boiled. Manson most sensibly recommends that during an epidemic the drink of a household should consist of weak tea and decoction of lemon, for both of which boiling water is necessary. Aerated waters should be avoided except such as are manufactured, like those of the "Salutaris" company, from distilled water. If aerated waters are manufactured with a basis of distilled water and in hygienic surroundings, they are quite incapable of conveying infection so long as the syphons and their fittings are cleaned both inside and out with steam, under pressure, before being refilled.

Public Health Administration.—All persons must be isolated in a suitable Hospital or camp, according to district

and climate, and all "contacts" if not segregated in Reception Houses ought, at least, to be kept under the strictest medical supervision in their own homes. The district in which the outbreak has occurred should be subjected to the most rigorous scrutiny, and its water-supply, drainage, and general cleanliness promptly attended to if in any way defective. There are few towns in Great Britain where, from the condition of water-supply, a large water-borne epidemic is likely to break out, since when the supply is from an adjacent river the water is filtered before it is distributed to the mains. The only exception which occurs to me at the moment is the town of Montrose, in Scotland, where the inhabitants still use an unfiltered water-supply from the river. But while the source of the water-supply itself may be pure, there is always the danger in an epidemic of cholera of one or other of the mains being contaminated, and the greatest care must be taken to avoid contamination of ground either directly or through a defective drainage-system. In moist soil the vibrio of cholera is capable of preserving its virulence for a long time. The condition of the source and distribution of the food-supply must be most carefully enquired into, as any contamination of milk or other food may do much to spread the disease. The methods of dealing with the infected area and infected houses should be similar to those adopted in the case of plague (q. v.), save that there is no need to inaugurate a campaign against rats.

The infected area should be visited constantly by medical men, who, besides looking for suspicious cases, ought to endeavour to infuse a spirit of cheerfulness and hope among the inhabitants, and drive out that fear which is, in cholera, such a powerfully predisposing cause of the disease. The people should be warned against the drinking of unboiled water. Filters of all kinds should be discouraged, as the only ones which are at all effective are those of the Pasteur-Chamberland type, and the ordinary charcoal filters are not only no protection, but a positive source of danger.

The question as to how far people coming from infected districts should be limited in their movements in non-infected areas is always a matter of discussion. In continental countries

ships coming from an infected country are strictly quarantined, and passengers are detained at frontier towns, roughly disinfected, and herded in ridiculous discomfort for some days, in the hope of checking the spread of cholera by these means. Such rigorous quarantine regulations disorder the trade of the infected country and lead to attempts being made to conceal the existence of cholera cases. The habit in Great Britain has been to examine all ships coming from infected ports, to isolate any persons who appear to be ill, and supervise the goings and comings of the other passengers until such time as there is no further risk of their developing cholera. The ships are thoroughly disinfected and cleaned before another crew is allowed on board. By means of these milder regulations business is not disorganised, and there is less likelihood of cases being concealed. The importance of not having cases concealed is obvious, and it is better for a district to have a dozen declared cases of a disease in its midst than one unknown or concealed case.

Prophylactic inoculations of graded strength have been practised by Haffkine, and in the course of an epidemic tending to grow at all large in one of our western cities this might well be tried as one of the means of protecting those at work among the sick, and of helping to limit the spread of the disease.

Chapter VI.

RELAPSING FEVER.

Synonyms.—Febris recurrens; Febris recidiva; Bilious remittent fever; Famine fever.

Fr.: Fièvre à rechutes.

Ger.: Rückfalls fieber; Hungertyphus.

Definition. — An acute infectious disease characterised by a sudden febrile onset, short course and rapid subsidence, followed at an interval of from 1-7 days by a relapse, which, with a similar intervening period, may be repeated an indefinite number of times. It is associated with the presence in the blood and tissues of spirochætæ, one of which was discovered by Obermeier in 1873, and another, usually called the Sp. Duttoni, by Ross and Milne, in Uganda, and Dutton and Todd, in the Congo, quite independently of one another. Carter described a spirochæta similar, apparently, to the Sp. recurrentis of Obermeier as occurring in the "relapsing fever" met with in India.

Incubation Period. — The incubation period is usually from two to six days, but may be prolonged to fourteen days.

Rash. — No rash is described as typical of the disease, but a roseolar eruption in character something between measles and typhus has been seen in rare instances.

Clinical Types.—It would seem that the type of relapsing fever as met with in Europe and India differs in certain particulars from that met with in Africa, and from this fact and because there are certain notable differences in

morphology between the spirochæta recurrentis of Obermeier and Carter and the spirochæta Duttoni, one is justified in saying that relapsing fever in Africa is a different disease from that met with in Europe and India, although both types are due to infection by a spirochæta, and in general resemble each other very closely. The experiments of Todd and Brei support this view, as they show that immunisation against the spirochæta of the Indian form of relapsing fever does not protect against the Sp. Duttoni.

European and Indian Type. — The onset is sudden, heralded by chill, rigors, giddiness, severe headache, nausea and vomiting. The temperature rises at once into high registers, 104° and 105° F. being quite usual readings, and it may even rise to 107° or 108° F. The pulse and respiration are notably increased in rate, but the respiration-rate is not increased proportionately to the pulse. Delirium may be present if the fever is high. The skin is dry and burning. As compared with typhus, the prostration is not marked, and the patient may walk to consult a doctor even in the second or third day of his illness, but giddiness is a very striking symptom. The face is flushed but not dusky and heavy-looking as in typhus. The tongue is moist, covered with a thick white fur, and thirst is usually extreme. Appetite is very variable, being in some cases entirely lost, and in others quite unimpaired. There is sometimes considerable pain and tenderness in the epigastrium, and the spleen is always enlarged, with marked tenderness on pressure over the area of splenic dulness. The liver also is most usually enlarged. A slight icteric tinting of the conjunctivæ is very commonly present, and in a fair proportion of cases generalised jaundice appears about the third day of the fever. In such cases the urine is bile-stained, but the stools remain dark in colour. The fever usually remains high for some five to seven days, showing no great degree of oscillation; the pulse varies with the temperature, and may be very rapid indeed. The patient suffers much from headache and pains in the back and limbs. Sleeplessness is almost always a source of trouble, and the mind usually remains clear although some delirium may be present. On the fifth, sixth or seventh day the fever falls

rapidly by *crisis*, and it is common to have, just before the crisis, a rise of temperature even of several degrees, while with the pre-critical rise violent delirium and restlessness may set in for a short time. The fall of temperature to normal or subnormal registers is very rapid—a fall of 8° or 10° F. in a few hours being quite common. Murchison records in one case a fall of 13° F. in six hours, and in another a fall of 14·4° F. in twelve hours. The crisis is usually accompanied by profuse sweating, and sometimes diarrhœa and epistaxis occur. As in all diseases where fever terminates by crisis, the sudden fall of temperature may be attended by dangerous and even fatal collapse. In aged and feeble patients death may occur with coma before the end of the first paroxysm. After the first crisis, there is an interval of apyrexia which lasts for a variable time, usually for five or seven days, but intervals as short as two and as long as twenty-five days have been recorded. During the apyretic interval the patient feels well and will, perhaps, be with difficulty restrained in Hospital, but at its termination he is suddenly seized with the same acute symptoms and rise in temperature as ushered in his first paroxysm. This *first relapse* may last as long as the first paroxysm, but is usually somewhat shorter and may last only for a couple of days. It terminates by crisis, as did the first paroxysm, and this may end the attack. But in some patients, after a short second period of apyrexia a *second relapse* occurs, which is usually milder than the preceding, and of short duration, rarely exceeding three days After its termination the attack is in most cases finished, but more rarely a third, fourth or even fifth relapse may occur. After the termination of the last relapse, convalescence is often a little tedious, and the patient does not recuperate with the same rapidity as after typhus, and his recovery may be delayed by certain troublesome complications and sequelæ. Throughout the attack, save at the time of the crisis, the bowels tend to be constipated.

The typical course of the disease is not always followed. In some cases there is no relapse after the first crisis, while in others there is no definite crisis at the end of the first paroxysm, but the temperature after an incomplete

fall tends to rise again and the patient drifts into a typhoid state in which he may die from asthenia, sudden cardiac failure, or suppression of urine with violent symptoms of uræmia. Such "typhoid" cases are commonly deeply jaundiced and vomit dark bilious material, while they sometimes have numerous hæmorrhages into the skin and from mucous surfaces, presenting a "hæmorrhagic" form of the disease.

African Type.—The "African" type of relapsing fever differs in many respects from the "Indo-European" type, although in general the manifestations are very similar. There is the same sudden onset and abrupt termination of the initial paroxysm and the same tendency to relapse after irregular periods of apyrexia. The initial paroxysm, however, is shorter than in the European type, and terminates in most cases about the end of the third day. The intervals of apyrexia are of very irregular duration, varying from one day to nearly three weeks, and the number of relapses is usually greater than in the "European" type, five or six relapses being the rule, and as many as eleven having been observed. The fever is shorter in the relapses than in the initial paroxysm, but rises quite as high. The intervals of apyrexia become longer as the attack proceeds. Another point of difference between the types is that in the "African" form diarrhœa and dysenteric manifestations are fairly common.

Diagnosis. — The diseases most likely to be confused with relapsing fever are malaria, enteric fever, typhus fever and influenza, but, although at the beginning of the attack there is little to distinguish it from typhus or enteric fever with a sudden and severe onset, the course of the disease, showing as it does a definite "relapsing" character, the first relapse occurring about fourteen days from the onset of symptoms, makes differentiation comparatively easy. The duration of the paroxysms distinguishes it from malaria. It is during the first paroxysm that differentiation from other fevers may be difficult, but the clear, vigilant look in the eyes and the absence of a dusky flush on the face will help to differentiate it from typhus, and the early enlargement of the spleen is unlike that seen in enteric fever. For accurate

diagnosis, however, we must depend on the microscopical examination of the blood and the detection of spirochætæ. The spirochætæ stain well with ordinary basic anilin dyes, and gentian violet is a convenient stain to use for the purpose after drying the film made from the blood and fixing it with absolute alcohol. Jenner's and Leishman's stains give very pretty results. The sp. recurrentis of Obermeier is a delicate spiral thread from 7 μ—9 μ long, while the sp. Duttoni of the "African type" measures some 16 μ in length, or about twice as long as the sp. recurrentis. The sp. Duttoni tends to form loops and coils of a "figure-of-eight" shape. In the "European" type of the disease, the spirochætæ are found in great numbers in the peripheral blood stream during a paroxysm, but in the "African" type they are apt to be scanty and difficult to find except after repeated examinations. It would seem to be quite possible that in various parts of the world "relapsing fever" may occur which is caused by spirochætæ differing in some degree from those described, but on this point further evidence is needed before any definite statement as to their occurrence can be made.

Complications. — These are not numerous, and the most serious, *lobar pneumonia*, is one of the rarest. Pneumonia has been fairly frequent in certain European epidemics, but quite uncommon in Great Britain. Sometimes the pneumonic consolidation breaks down and results in gangrene of the lung. *Bronchitis* is very common, but is seldom more than a very slight catarrh of the larger bronchi. *Diarrhœa* and a form of dysentery have been troublesome complications during certain epidemics, and *rupture of the spleen* and the *breaking-down of a splenic embolus* have occasionally been noted as a cause of death, the former resulting in violent hæmorrhage, and the latter in general peritonitis. *Parotitis* and *inguinal bubo* sometimes occur, and have been, in some epidemics, a most unfavourable sign, but in Great Britain they seem to have occurred most frequently in cases which ultimately recovered. Pregnant women near always *abort*, but the abortion is not uncommonly delayed till the relapse. When abortion does occur it is frequently fatal, and the child is still-born or dies within a few hours.

Sequelæ.—*Multiple neuritis, synovitis,* associated with severe articular pain and sometimes with effusion into the knees or ankles, *nephritis* and a form of *ophthalmia* have all been observed as sequelæ of relapsing fever. The ophthalmia occurs first as an affection only of the retina and choroid, but involves secondarily the more superficial structures, and is then associated with severe pain. Only one eye is commonly involved, but recovery is always tedious, while in a certain proportion of cases vision is lost.

Treatment. — No drug treatment has yet been introduced which has been successful in cutting short the course of the disease, and treatment, in the absence of serumtherapy, must be palliative and symptomatic. Where the bowels tend to be constipated, a mild aperient should be given throughout the attack. The patient may be made more comfortable by cold or tepid sponging, and by the application of cold to the head, either by cloths dipped in iced water or by means of a Leiter's coil. When epigastric or hypochondriac pain is severe the giving of an emetic, followed by the application of tepid compresses to the abdomen may afford relief. It is wise to give a simple diuretic or diaphoretic mixture consisting of Liq. Ammon. Acet. ℥i, Potass. Acet. grs. x, and Spr. Aetheris Nitrosi ♏xv, at three-hourly intervals throughout the attack, as one of the dangers of the disease is scanty urinary output with symptoms of uræmia. Should uræmia be seriously threatening, it is well to give an intracellular injection of hot saline solution, and bleeding may be resorted to in addition. Opium may be of service in the relief of pain and sleeplessness, either alone in the form of Battley's solution or in combination with a small dose of chloral hydrate, while powdered opium either alone or in the form of Dover's Powder may be helpful when there is much diarrhœa, or when there is a tendency for the stools to be dysenteric. Alcohol may be used with advantage at the time of crisis, in small, frequently repeated doses.

Diet. — The diet should be fluid, consisting of milk, barley water and beef-tea or some clear soup, during the periods of fever, and after the fever has declined, a semi-solid

diet may be given at once, if there is no diarrhœa or nephritis present. During convalescence a mixed diet may be rapidly resumed according to the patient's wishes and capacity.

Epidemiology.— Relapsing fever has not occurred in Great Britain in any considerable epidemic since 1870. One death occurred in Glasgow in 1879, and three in Ireland in 1890, but since then no cases have been observed in the British Isles. It is still met with, however, in Eastern Europe and in Asia, and the "African" type is common in the region of the Great Lakes and on the Congo. Relapsing fever is usually associated with unusual poverty and squalor, with consequent enfeeblement of health, so much so that in many of the epidemics which appeared in the large towns of Great Britain, the vast majority of the cases were destitute Irish people who had just left their native country, while the English and Scottish inhabitants were attacked in small numbers. But it is quite conceivable that with the practically unrestricted alien immigration which is usual in this country, the disease may once more gain entry to British towns, and the great mass of filthy and destitute people, and the dirty and insanitary condition of certain portions of our towns would form a very suitable nidus for a severe epidemic.

Death Rate.—This is low as compared with most of the infectious fevers, from 4 to 6 per cent. being usually given as the average mortality in an epidemic.

Method of Infection.—There seems to be little reason to doubt that the "European" type of the disease is conveyed from person to person by vermin, particularly by bed-bugs and body-lice, and it seems probable that the apparent spread of the disease by clothing and bedding has really been due to the fact that such clothing or bedding has been the habitat of some of these parasites. In the "African" type, the infection is spread by a form of tick, the *ornithodorus moubata.*

Home Prophylaxis.—The strictest cleanliness of house and person must be observed, in view of the possibility

of the transmission of the disease by vermin. Those in contact with the patient should avoid contamination by the discharges as far as possible, especially if the case be complicated with pneumonia or be of the hæmorrhagic type. Abrasions of the skin should be carefully cleaned and sealed up with collodion or "new skin." Patients in the poorer localities of an infected district should not be kept at home, as the dilapidated plaster and wood-work in such districts harbour vermin in large numbers and proper isolation is impossible. In Africa, the traveller should avoid as far as possible old camping-grounds and native villages, and should use a mosquito-net and a bed elevated some distance above the ground. A night-light is also an advantage, as the *ornithodorus moubata* makes its attacks usually in the darkness and may be deterred by light.

Public Health Administration.—As in cholera and plague, the duty of the Health Office is to see to the strict isolation of all affected patients, to remove to hospital all those attacked who are living in squalid and crowded districts, to thoroughly cleanse and disinfect all houses where cases have occurred, and all articles which have been in contact with a patient.

Strict supervision of contacts and suspected cases must be exercised, and opportunity afforded to practitioners for bacteriological diagnosis, either by the examination of blood-films alone, or by animal inoculations.

Chapter VII.

MALARIA.

Synonyms.— Ague, Intermittent Fever, Marsh Fever.

Fr.: Malaria, Fièvre intermittente, Fièvre Palustre.

Ger.: Malaria, Wechsel Fieber, Sumpffieber.

Definition.— An acute disease characterised by attacks of fever, usually of a periodic character, separated by variable intervals of more or less complete apyrexia, due to the presence in the blood and viscera of a specific sporozoon discovered by Laveran in 1880. The host of this sporozoon is the mosquito, by which it is conveyed to man.

Incubation Period.—The incubation period for malaria seems to vary from about twenty-four hours to several weeks. Instances have been recorded of patients developing the disease within twenty-four hours of their arrival in a malarious district, and, on the other hand, I recollect a patient, who had never previously suffered from malaria, but who, after staying a week in New Orleans during September, sailing from there in a tramp steamer to the Netherlands and Germany, and afterwards coming by easy stages to Liverpool and Glasgow, developed malaria after he had been ashore and exposed to the chills of a Scottish December for a fortnight. His attack was a benign tertian.

Rash.—No typical eruption has been observed in malaria.

Clinical Type.—The three main types of malarial fever are the Tertian, the Quartan, and the Aestivo-Autumnal or Malignant Malaria.

1. *Tertian Malaria* is so called because the febrile paroxysm occurs on every alternate day. (See Chart 1.)

The febrile paroxysm is clinically divided into three stages, the "cold stage," the "hot stage" and the "sweating stage." At or about the same time in each day on which a paroxysm occurs, the attack is ushered in by the development of the *cold stage*, in which the patient is seized with a feeling of chill and shivering, and almost always has a marked rigor, which is sometimes so severe as to make standing upright impossible without support and to shake the bed or couch on which he lies. The "cold stage" is sometimes preceded by some hours of general discomfort and lassitude, with subjective sensations of nausea, slight headache, pain in the bones and a feeling of cold water trickling down the spine. During the stage of premonitory symptoms the temperature often rises slightly. In some instances the premonitory symptoms pass off without being followed by a properly developed paroxysm of the disease, but usually after a few hours they are followed by the chill and rigor which characterise the onset of the "cold stage." The feeling of chill is purely subjective, as although the hands and feet are cold to the touch, the temperature in the axilla and rectum is seen to rise during the whole period of chill and rigor. At the same time the patient suffers acutely from headache and nausea and may vomit severely. His face is pinched and pallid, with some cyanosis of the lips and ears, and he heaps coverings on himself in the endeavour to get warm. In young children the rigor is sometimes accompanied by convulsive seizures.

After the "cold stage" has lasted for about an hour, the *hot stage* begins, in which the patient begins to feel warmer, and the feeling of warmth rapidly increases, alternating sometimes with chilliness for a short time, until within an hour he suffers from burning heat and discards the coverings which he has heaped on himself during the "cold stage." During this period the temperature rises still further until it may reach very high levels indeed, temperatures of 106° F. being frequently recorded. The face is flushed, the skin dry and burning, headache is severe, and vomiting may be distressing. The pulse is full and bounding and respirations are rapid.

After one or two hours of acute discomfort, the final or *sweating stage* of the paroxysm is reached. The patient

breaks into a profuse perspiration, the feeling of heat passes away, the fever declines, headache and nausea disappear, and the pulse and respiration become quiet. The sweating lasts one or two hours, and when it ceases the patient feels tranquil and languid, and in a few hours he may feel well enough to go about his work again. The whole paroxysm thus lasts for about six hours, and in the tertian type is not repeated on the following day, but is repeated on the day after, in all its stages, at or about the same hour as it occurred two days earlier.

The spleen enlarges during the paroxysm and recedes at first during the apyretic interval, but after several paroxysms the spleen remains enlarged during the interval, still tending to increase somewhat during the paroxysm.

The urine is passed frequently during the cold stage, and at this period is actually increased in quantity above the normal. The excretion of urea is also increased during the paroxysm, and for some hours afterwards.

It is possible to have two attacks of tertian ague running at the same time, so that each day may be occupied by a paroxysm, and a *quotidian* character given to the fever. The clinical manifestations often bear evidence of this apart from microscopical examination of the blood, inasmuch as the attacks on two consecutive days may vary greatly in severity and may reach their height at quite different times. (See Chart 2.) This is not always the case. Two tertian infections may mature at about the same time each day, and present a picture of a quotidian ague having its maximum swing about the same hour. But the infecting organism presents no difference from that found in an infection with regular tertian manifestations, so that even when the quotidian paroxysms appear at or about the same hour each day, we are bound to consider the attack to be a *double tertian*, due to two infections by the parasite of tertian malaria, which mature on different days.

2. *Quartan Malaria*: In the quartan type of the disease the paroxysms are separated by an interval of two days of apyrexia (see Chart 3), but are made up of the same three

stages of cold, heat and sweating as in the tertian type of the disease, and have a similar duration. A double or triple infection by the quartan parasite may take place, so that two consecutive days may show a paroxysm, followed by a day of apyrexia, or the paroxysms may occur daily.

3. *Aestivo-Autumnal* or *Malignant Malaria.*—In this type of the disease the paroxysms are not quite the same as in the benign tertian and quartan fevers. In certain cases they follow a regular type, and are separated from each other by a definite period of apyrexia. (See Chart 4.) In such cases the rigor may be much less severe than in the benign types, but the hot stage lasts longer, sometimes occupying twenty-four hours. It is not uncommon in this type of infection to have a fall of some degrees of temperature, or pseudo-crisis, some hours before the real termination of the paroxysm. In other cases of malignant infection the paroxysms are well defined, of short duration and occur daily, and there seems reason to believe that many of the quotidian types of ague, apart from the double infection by the tertian parasite, may be due to a separate organism, which has not yet been fully studied and described. Another type due to a malignant infection is the *remittent* (see Chart 5), where no period of apyrexia separates the paroxysms, but where the termination of one is not complete before another begins. In such cases the stages of the paroxysms are usually not well marked; rigor may be replaced by a sensation of chill, and sweating may be no marked feature during the decline of the fever. In other cases the febrile movement may be very slight and quite irregular. Part of the irregularity in the manifestations is, doubtless, frequently due to previous dosing with quinine, as it is quite uncommon to find Europeans who have been in a malarious district for any length of time who have not used quinine for prophylactic purposes. At the same time, apart from the administration of quinine, the manifestations of a malignant infection, especially if the infection has been repeated several times, tends to be accompanied by febrile movements which may be slight and atypical, although the other constitutional disturbances may be grave. (See Chart 6.) A malignant infection may be accompanied by

jaundice, with much vomiting (the *bilious remittent* type of the disease), and in some cases may be speedily followed by cerebral symptoms, such as stupor, convulsions and coma. In such attacks the temperature may rise to very high registers, and death may occur with a hyperpyrexia of 109° or 110° F.

Yet another form of the disease may be developed by a malignant infection—the *algide form*, characterised by collapse, coldness of the surface of the body and a tendency to syncopal attacks. Vomiting may be present, or profuse watery diarrhœa with collapse closely simulating cholera, or hæmorrhage from the bowel or stomach. In other cases, particularly in such as show signs of cachexia, the sweating stage may be associated with a proneness to sudden cardiac failure, which may be induced by an injudicious movement on the patient's part. It is cases of this kind that show how important it is that an early and accurate diagnosis of the particular infecting organism should be made.

Mixed Infections.—In certain cases of malaria more than one kind of infecting organism may be present, and in these cases the disease may show most irregular manifestations, due to a blending of the benign types of tertian and quartan malaria, or to a mixture of the benign and the malignant infections. Such cases can only be elucidated by the careful and systematic examination of the blood, and the recognition of the various infecting organisms.

Mild types.—In many instances, a person living in a malarious district suffers from headache, nausea and general malaise for some hours without the occurrence of rigor, heat or sweating, and this attack may be repeated, with intermissions of varying length, several times, and in some such cases a typical attack of malaria develops out of the attack. In others, however, the symptoms are apparently not prodromal to an attack of true malaria, but constitute in themselves an abortive attack of the disease, ultimately disappearing without the development of a febrile paroxysm.

Diagnosis. — The only accurate means of diagnosis in malaria is the microscopical examination of the blood and the detection of one or other of the forms of the malarial parasite.

The three parasites usually described are the *tertian*, *quartan*, and *malignant*.

For those who have not had great experience in malaria it is wise to examine dried films of blood which have been stained by the Romanowsky method or one of its modifications. Personally, I prefer to use Jenner's or Leishman's stains as being both simple to manipulate and effective in action. When stained by these methods the red blood corpuscles appear brownish-red, nuclei appear blue and the parasite shows a blue protoplasm with red chromatin.

The *benign tertian* parasite when stained appears in a red blood corpuscle as a small blue ring, with one part of its circumference slightly thicker than the other, containing a bright red spot of chromatin. As it grows it is seen as a more or less regularly-stained blue mass of protoplasm, containing fine granules of pigment which it has acquired from the red blood corpuscles. The red blood corpuscle enlarges with the growth of the parasite, assuming the appearance of a large megalocyte, and is occupied almost entirely by the parasite when it has reached maturity. The parasite matures both as a sexual and an asexual form. The sexual form is practically undistinguishable from a full grown asexual parasite before sporulation has taken place, *i.e.*, it appears as a large more or less homogeneous protoplasmic mass stained blue, containing numerous pigment-granules and irregularly distributed chromatin. In the asexual form, which is proceeding to spore-formation, the pigment collects itself, as the parasite grows, into two small masses at the centre, while the chromatin gathers at the periphery. Radial segmentation of the organism occurs, and the result is a grouping of some fifteen to twenty-six oval spores, each containing a red dot of chromatin, like a bunch of grapes round one or two central masses of coarse brown pigment. The remains of the red blood corpuscle, at least from the time that the organism is half-grown, show, in deeply stained specimens, an appearance of granules to which has been given the name of "Schüffner's dots." Immediately before the occurrence of a febrile paroxysm, the corpuscle ruptures and the spores are set free in the blood-stream.

The spores may invade other red blood corpuscles and be the starting point of another cycle. The sexual forms, or "gametocytes," do not develop fully in the human blood, but when removed from the body certain of them remain as large roughly spherical bodies, with a faint appearance of segmentation in the protoplasm. These are the female forms or "macrogametes." Others produce pseudopodia, which constitute the male element of the parasite, and become detached, appearing as elongated motile bodies, the "microgametes," which effect conjunction with the female macrogamete. Pseudopodia are never seen in the circulating blood, but the formation of flagellate forms are frequently seen during the examination of fresh specimens of malarious blood under the microscope, especially when a hot stage is used. I have seen one such flagellate organism under a high power, surrounded by three large polymorpho-neuclear leukocytes who ultimately consumed it, and went off with pigment in their interiors.

The *quartan parasite* is much smaller than the tertian, and does not grow beyond the size of a red blood-corpuscle. In its early or "ring-form" stage it is quite indistinguishable from the tertian parasite, but the fact that it does not cause enlargement of the red blood corpuscle as it reaches full growth, and that the protoplasm of the red blood-corpuscle does not show "Schüffner's dots" are notable points of difference. The quartan sporulating form is much smaller than the tertian, and the segments, some eight or ten in number, are arranged in characteristically regular, "daisy-like" formation round a central dense mass of very dark pigment. Microgametes and macrogametes are formed as in the tertian parasite.

The "*malignant parasite*" is still smaller than the quartan, and, indeed, to those unskilled in the examination of the blood for the malarial parasite it may, even in stained specimens, readily escape notice in its early or "ring" form. The blue ring is often of hair-like thinness, even under an oil-immersion lens, and the chromatin-dot is very small indeed. This makes the detection of the parasite in many cases a matter of extreme difficulty, as it is very uncommon to find

sporulation forms of the "malignant" parasite in the peripheral blood-stream, although it has been observed in certain cases, and one is usually dependent on the detection of the "ring-form" for the formation of a diagnosis. The sexual form of the parasite is, however, very characteristic. It appears as a crescent-shaped body, to the concavity of which is usually seen adhering a fragment of a red blood-corpuscle. The crescent-body stains a pale violet and shows in its centre an agglomeration of fine granules of pigment. This form is rarely visible during a febrile movement. The sporulating forms are very small, and show an irregular heap of from six to twelve spores. The blood-corpuscle which has been invaded by the malignant parasite frequently shrinks, becomes darker in colour than the normal, and tends to show a crenated margin.

While this description applies generally to all the forms of malignant parasite, it is only right to say that Manson, following Italian observers, recognises three malignant parasites, viz.:—(1) the ordinarily-described parasite of malignant tertian ague, *Laverania malariæ*, which displays a fine pigment; (2) a pigmented quotidian parasite, *Laverania præcox;* and (3) an unpigmented quotidian parasite, *Laverania immaculata*. Of the two pigmented forms, *Laverania malariæ* is the larger, being about $\frac{1}{2}$-$\frac{2}{3}$ the size of a red blood-corpuscle, while *Laverania præcox* is just one half of that size. In both of these parasites, pigment can be seen scattered through the partly matured forms and collected in small irregular masses in the centre of the sporulation and crescent forms.

The *blood* in malaria presents certain characteristics apart from the presence of the parasite, which may arouse a suspicion in the mind of the physician that the case is one of ague. Some degree of anæmia is always present, and in malignant cases the red corpuscles tend to show a diminution in size, a density greater than normal, and a crenation of their edges. The presence of pigment in the leukocytes or free in the blood-stream should always suggest the possibility of an otherwise unexplained pyrexia being of malarial origin if there is any possibility of the patient having acquired the infection, even some years previously.

The accurate diagnosis of the malarial parasite is a matter of great importance both as regards prognosis and treatment, as the possible effects of a benign and malignant quotidian or tertian fever are widely different in range and severity. It is not likely that a tertian or quartan malaria will be mistaken for any other disease, the regular periodicity is so striking and characteristic, but in malaria of the quotidian, remittent, or irregular types, while the association of the fever with splenic enlargement and previous residence in malarious districts may arouse suspicion although the patient falls ill in a non-malarious country, accurate diagnosis is impossible without the detection of the infecting parasite. Even the test of quinine-treatment by the mouth will fail in certain obstinate cases. It is to be remembered that the acquiring of some other infectious fever may in some cases arouse even a long-dormant malaria, and the difficulties in diagnosis presented by an attack of enteric fever complicated by a concurrent attack of malaria have given rise to the name "typho-malarial fever," which has been frequently given to such cases. Only careful examination of the blood by the making of cultures, by the performance of Widal's test, and by the discovery of the malarial parasite on microscopical examination will definitely reveal the true character of the illness.

Complications.—In certain cases of intermittent malaria of a "low" or "adynamic" type, profound nervous depression, rapid blood-destruction, hæmorrhages from various mucous membranes, and local gangrene may supervene as complications. The hyperpyrexia, cardiac failure, convulsions and loss of power which occur in some malignant infections, are so much a part of the algide and cerebral types of the disease that they cannot well be classed as "complications."

Sequelae.—The sequelæ of repeated attacks of malaria are best described as forming a part of the "malarial cachexia," a general deterioration of health associated with anæmia, enlargement of the spleen and, most usually, with a tendency to irregular febrile attacks, especially following chill or any unusual mental or physical strain. The patient

is pallid and anæmic looking, with a peculiar dull yellowish colour of the skin and very frequently some yellow tinting of the sclerotics. This condition of cachexia, while usually following on repeated attacks, may be established by one very severe attack of the disease, and may even result from prolonged residence in a malarious district without the patient having had any recognisable malarial paroxysm. The cachexia may be present without fever, although this is not usual. Splenic enlargement is sometimes enormous, and although the "ague-cake" is frequently firm and even hard on palpation, rupture from very slight violence of a chronically enlarged spleen the result of malarial infection is quite common. This is one of the reasons why "kicking a nigger" is discouraged by European administrations in Africa and India, while among natives of malarious countries a blow over the spleen is a favourite way of getting rid of an enemy. In very malarious districts splenic enlargement is often found in young children, and it is even said that infants are sometimes born with an enlarged spleen as the result of chronic malarial poisoning of the mothers.

Sometimes when malarial cachexia appears in childhood, development is greatly retarded, so that a person of twenty-five years of age may look like a child of eleven or twelve.

Malarial cachectics are often very prone to severe hæmorrhages. In such cases a very slight operation, such as a tooth-extraction, may give rise to a profuse hæmorrhage which may be difficult to control, and the greatest care must be taken, in this class of patient, in advising or performing any operation even of the most trivial description. Epistaxis, hæmatemesis, hæmaturia, retinal hæmorrhages, and purpura may occur without any operative interference, and such occurrences are of grave import, indicating, as they do, a very profound degree of cachexia.

Neuroses of various kinds have been observed in connection with the malarial cachexia, and the striking point about them is that they may be definitely periodic in their occurrence. We may see quotidian, tertian and quartan attacks of neuralgia, pain in the epigastrium, vomiting, headache, and even diarrhœa, or attacks of sneezing and palpitation. *Herpes*,

erythema nodosum, urticaria, and *eczema* have been observed, and in a few instances *synovitis* has been noted, all showing a periodic tendency to exacerbation and improving under treatment by quinine.

Peripheral neuritis has been observed associated with the presence of the malignant parasite in the blood.

Organic changes of a fibrotic kind in *heart, kidney, liver* and *spleen* are frequently met with in cases of long continued cachexia, and cachectics are very liable to *bronchial catarrh* and *broncho-pneumonia* as a result of chill.

Blackwater fever.—It is perhaps against the convictions of many to place blackwater fever in the list of malarial sequelæ, but it is, I think, more unreasonable to class it as one of the dangers of the quinine treatment of malaria. The hæmoglobinuria which follows so rarely on the taking of large doses of quinine disappears when the drug is withdrawn, and this is very far from being the case in blackwater fever. Manson chooses, with considerable reason, to class it as a separate disease pending further information. But there is no doubt that blackwater fever occurs habitually in malarious districts and usually attacks a patient who has been the subject of some degree of malarial infection, the manifestations of which may have been obscured by the use of quinine. The fact that it has become apparently more common in recent years in the West Coast of Africa and in British Central Africa may be due, as Crosse suggested, to its having been only recently separated clinically from the "bilious remittent" type of malaria. Its onset and course are similar, and it is not always easy, save by appropriate chemical tests, to distinguish a very deeply bile-stained urine from hæmoglobinuria. But the evidence of careful observers in British Central Africa and British East Africa goes to show that it is at least very frequently associated with the presence in the blood of the malignant parasite of malaria, and that it tends to yield to quinine suitably administered. It would seem that this hæmorrhagic type of malaria is influenced by certain local conditions, as it tends to appear almost in epidemic form in certain districts in Africa which, after the

occurrence of numerous cases during one year, may be practically free of blackwater fever for several seasons. But this is no argument against its being of malarial origin, as anyone who has had experience of smallpox will remember how in certain epidemics the hæmorrhagic type of the disease is scarcely seen, while in others it appears with uncomfortable frequency. It is possible that certain cases of blackwater fever may be due to an infection other than malarial and may bear the same relation to some tick-borne fever as others bear to malaria, but at present due consideration must be given to the opinion expressed by Crosse and other observers in Africa, that in the majority of cases it is due to an infection by a malarial parasite and will yield to quinine, since their experience of the condition as met with in Africa must far outweigh that of Koch and others who were mere visitors to the districts. Certainly in the one case which I have seen, the condition appeared in a man, who had been previously the subject of a malignant malarial infection, several months after he had landed in Great Britain, during which time he had not used quinine. The malignant parasite was present in his peripheral blood in very small numbers, extremely difficult to detect, and the condition yielded in a day or two to intramuscular injections of quinine. It seems, on the other hand, to be certain that in some cases quinine does not cure, even when given properly, but the objection to quinine in the treatment of blackwater fever by those who have given it only by the mouth must not be taken too seriously.

Treatment.—During a paroxysm, the patient ought to go to bed as soon after the commencement of the rigor as possible, and remain there until the sweating stage is over. During the cold stage he should have hot drinks and be covered warmly. In the hot stage, his discomfort may be alleviated by tepid or cold sponging, and headache may be relieved by the application of cold cloths to the forehead. Should vomiting be severe, the application of a mustard poultice or mustard leaves to the abdomen will often help to check it. During the sweating stage, when the fever is declining, his clothes should be changed rapidly and the surface of the body dried as occasion needs, and any tendency to

collapse may be met by hot applications over the heart and the hypodermic injection of strychnine and ether, while small doses of alcohol by the mouth or rectum may be called for.

In the intervals between the paroxysms, should the attack be tertian or quartan, the patient may be allowed greater liberty, but it is well to discourage any great physical or mental activity until the attack has been subdued by quinine. In the vast majority of cases, quinine, properly used, will cut short the attack, so that only one or two paroxysms may occur. When the attack is of the tertian or quartan type, it is well to withhold quinine until the paroxysm is over, and then to give it in solution in one or two ways. It is to be remembered that the commencement of the paroxysm coincides with the maturation and rupture of the sporulating forms of the parasite, so that to be effective in checking the onset of the day's paroxysm, quinine must be given before such maturation can occur, thus preventing the liberation of the spores, both to anticipate the paroxysm and to prevent the formation of a new brood of the parasite. As it is thought that the parasite is most vulnerable between its half-grown and its mature stage, it is the practice of many physicians to begin treatment with quinine by giving one large dose of 20-25 grains each day an hour or two before the time at which the paroxysm is expected to occur, and this method, which is the one used largely by British physicians in Spain, is certainly very effective, and tends less to the saturation of the tissues by the drug than the employment of repeated small doses approved of by others. It has one disadvantage, in so far as it may, in susceptible persons, produce the uncomfortable symptoms of cinchonism—deafness, ringing in the ears, headache, vomiting and an intolerable urticaria, but such susceptible people are comparatively rarely met with, and if the patient is at rest during the time of treatment, severe cinchonism is not very likely to occur. Those who prefer to use quinine in smaller quantities frequently repeated, give doses of 5 grains at intervals during the day, beginning just after the sweating stage is ended, until 30 grains have been given. Another method of administration is to give 10 grain doses at 5 a.m., 8 a.m. and 11 a.m. and this has the advantage over the large

single dose of lessening the risk of producing cinchonism. Where the large single dose is used, it should be repeated daily for some four or five days. The dose should then be reduced by one half and given for a week, when it should be further reduced by one half and continued for ten days or a fortnight. When the smaller repeated doses are employed, they should be continued regularly for a week, and for a week thereafter they should be reduced in frequency so that 15 grains are taken in the twenty-four hours, while for yet another fortnight 10 grains should be given each day.

In the treatment of a *quartan* ague, it is well to wait, as in the case of a tertian, until the paroxysm has subsided before giving quinine, and if the large single doses are used they must be continued for a week, and reduced in a correspondingly more gradual way as compared with a tertian attack. When the small repeated doses are used the initial number should be continued for ten days, while 15 grains daily should be continued for ten days, and 10 grains daily for another fortnight. The different types of malaria behave very differently under treatment. A benign quartan attack is more easily checked by small doses of quinine than a benign tertian, but shows a much greater liability to relapse—while its manifestations are very easily subdued, it is difficult to eradicate. A benign tertian, on the other hand, while sometimes rather difficult to check, shows much less tendency to relapse after reasonable treatment.

A *malignant infection* is the most troublesome of all, not only because of its comparatively refractory behaviour towards quinine, but on account of its tendency to be accompanied by the more pernicious symptoms of the disease and its liability to induce cachexia. It is not necessary to give quinine otherwise than by the mouth during the early stages of a mild malignant infection, but it should be given as soon as the diagnosis is made, irrespective of the presence of fever at the time. On the slightest hint of the onset of nervous symptoms as indicated by drowsiness or coma, restlessness or delirium, it should at once be given intramuscularly, as any delay in getting the patient thoroughly under the influence of quinine

may result in his death. Similarly, on the occurrence of any of the so-called "algide" symptoms, quinine must be given intramuscularly or intravenously without delay. If quinine is being given by the mouth and the malignant attack continues, even with slight febrile manifestations or periodic neurotic symptoms, for more than a few days, it is well to resort to intramuscular or intravenous injections, as the danger of a severe cachexia following on a prolonged malignant infection is considerable. To many, these recommendations may appear to be signs of over-anxiousness, but most people who have seen the sudden occurrence of nervous symptoms which have ushered in a fatal termination, during a rather prolonged but apparently mild attack of malignant malaria, will agree that it is well to prevent such symptoms rather than to be compelled to treat them. It is impossible to foretell the occurrence of cerebral or algide symptoms, and it is necessary to realise that they may appear during the course of any malignant infection, however apparently mild its manifestations may be. Those who have worked in malarious districts seem to acquire, to a certain extent, that contempt of mild attacks which is born of over-familiarity, but it may be taken as true that many deaths from malaria, and many cases of malarial cachexia, are absolutely preventable if the patient is able to take sufficient care and the physician is alive to the importance of accurate diagnosis and prompt and efficient treatment. Quinine should never be given by the mouth in powder or pill, but in solution, and the most convenient salt to use is the bi-hydrochloride, which has a solubility in water of 1 in 1. This salt is less irritating to the stomach than the sulphate, and its solubility lessens the possibility of the quinine not being absorbed. It is most probable that much of the enormous doses of the sulphate of quinine in powder, said to have been taken either for curative or prophylactic purposes, never dissolved at all, but passed through the body pretty much as it was ingested. The same salt is convenient for intramuscular injection, and should be given in doses of from 7-10 grains dissolved in 30-60 minims of water repeated in severe cases two or three times in the day. Intramuscular injections should be con-

tinued for a week, the best site for injection being the gluteal region, care being taken to avoid large nerves.

Bacelli, one of the best known of Italian physicians, uses the bi-hydrochloride of quinine 1 gramme, sodium chloride 75 centigrammes, with distilled water 10 grammes, as a solution for *intravenous* injection in malaria of a pernicious comatose remittent type. He injects into a vein from 5-7 grammes of the solution at a time, and states that he has reduced his death-rate in such cases to 6 per cent., as against the death-rate of 17 per cent. which he had when he employed the intramuscular injection.

Calomel should be given in doses of 3-5 grains at the commencement of treatment, and, as in all fevers, free movement of the bowels at the beginning of an attack is good practice.

In all cases of malaria, when a few hours' delay in the beginning of treatment with quinine is at all justifiable, it is well to give calomel or blue-pill, followed by a saline aperient, before giving quinine. In this way, the risk of the occurrence of cinchonism is greatly lessened.

Algide and *dysenteric symptoms* require the use of small doses of opium as well as quinine. *Hyperpyrexia* should be treated by prolonged immersion in a tepid or cold bath while ice is applied to the head.

Malarial Cachexia.—The treatment of malarial cachexia resolves itself into attacking the malarial parasite with quinine if it be present, preferably by intramuscular injections, and dealing with the anæmia by the use of arsenic and iron, while special conditions may call for special treatment. Malarial cachectics should leave malarious districts and spend at least one year in a temperate, non-malarious country. They should scrupulously avoid chill and damp, and ought to clothe themselves warmly and pay particular attention to wet feet. Quinine should be taken for two or three months after leaving malarious districts.

The enlarged spleen is best treated by counter-irritation, using either linimentum iodi or unguentum hydrargyri biniodidi, or a more heroic practice may be resorted to, which is sometimes very successful, the injection of 20-30 minims of turpentine subcutaneously into the abdominal wall overlying

the splenic enlargement. This produces a species of abscess-formation, and is frequently followed by a reduction in the size of the organ.

Hepatic enlargement and congestion are best dealt with by a course of treatment at Carlsbad, Kissingen, Vittel, or Harrogate, but when this is not possible, it is well to give the patient systematic treatment by saline aperients in the morning for several weeks.

The treatment of *blackwater fever* is, as has been already seen, a very vexed question. Where the belief is held, as in the case of Koch, that blackwater fever is definitely due to previous treatment by quinine, that drug will naturally be withheld, and treatment by arsenic or other drugs substituted. Where, however, its origin is believed to be mainly malarial, especially if even a very few parasites are discovered in the blood, quinine will be employed. The results obtained by many physicians in British Central Africa certainly justify the serious trial of quinine, but the quinine must be given intramuscularly and in a similar dosage as is employed in a severe remittent case of malignant malaria, or Bacelli's intravenous method may be employed. At the same time it is best to withhold all food by the mouth and give alcohol by the rectum, alternating with small rectal injections of physiological salt solution.

Diet.—During the febrile stage of the disease, whether the infection be benign or malignant, the diet should consist of clear soups and milk diluted with barley-water or rice-water, and during the earlier stages of treatment by quinine a very light diet consisting as far as possible of carbohydrates, fish, eggs and chicken should be employed. While there is no reason, in most cases of malarial cachexia, why meat should be withheld, it should be given very plainly cooked, grilled for preference, and in moderate quantities. In certain cases of cachexia, especially those associated with organic disease of the kidneys and liver, the diet must be restricted as in the earlier stages of treatment by quinine, while in others, the extreme irritability of the stomach will prevent any diet other than milk and milk-foods being tolerated. When convalescence is thoroughly established as full and generous a

diet as is within the patient's toleration should be given. It may be necessary in cases with obstinate vomiting to give the stomach absolute rest while the vomiting is present, and feed the patient entirely by the bowel.

Epidemiology. — Malaria is endemic in most parts of the world to-day save in the very cold latitudes, but is more prevalent in warm than in temperate climates and more prevalent in sub-tropical and tropical countries than in the merely warm. Tertian malaria has a practically universal distribution, but the other two types, the quartan and malignant, are not so universally distributed, the quartan being commoner in temperate and fairly warm countries, while the malignant is more prevalent in sub-tropical and tropical districts. In those warm countries, not sub-tropical, in which malignant malaria appears, as in Spain and Italy and parts of the United States of America, its prevalence is governed to some extent by the season of the year, first cases tending to appear in late summer and early autumn, and for this reason the name "Aestivo-Autumnal" has been given to the type. Malaria is much less prevalent in Europe than it used to be, on account of the improved drainage and sanitation which has been introduced into most Western countries during the past century. Chill is a predisposing element in the production of an attack, and while in merely warm countries a first attack of malignant malaria may be acquired in summer or autumn, the chills of winter and spring may induce a second attack when the infection is latent, and in those who come to cold or temperate climates after residence in malarious districts the determining factor in the production of another attack may be the arrival in England or the Northern parts of America during the cold weather.

In temperate climates malaria is frequently associated with the presence of swamps, but in warmer regions this is not so marked, although the existence of pools of still water are absolutely necessary to the breeding of the mosquito with which malaria is so closely connected. In some districts the rainy seasons are malarious, in others malaria is less during the rains. This, as Manson points out, is simply due to the fact that in some districts the rains wash out the local

mosquito-pools and in others are just sufficient to fill them. The disturbance of soil in malarious districts is often productive of a marked outbreak of the disease. The reason for this is not at first apparent, but to quote Manson again, "soil dis- "turbance usually means the formation of holes; holes imply "puddles, and puddles imply mosquitoes. Workmen from "many districts, some of them malarious, are assembled in "crowded lodgings; one infected workman suffices to start "the epidemic.

Method of Infection.—The work of Manson and of Ross has placed it beyond argument that the mosquito is an essential factor in the infection of man by the malarial parasite. The mosquitoes which have been found to act as intermediary hosts of the parasite belong to the group Anophelinæ, and, so far, no other group of the mosquito-family has been found to be capable of carrying the malarial parasite. When a mosquito sucks infected blood into its stomach the sexual forms of the malarial parasite appear as hyaline or male, and granular or female, spheres. The male spheres exflagellate and the detached flagella, or *microgametes*, penetrate a granular sphere or *macrogamete*. The conjugation of these two bodies results in the formation of a lanceolate form capable of movement, which penetrates the wall of the mosquito's stomach and comes to rest between the longitudinal and transverse muscular fibres. The parasite then acquires a capsule, and develops in its interior a great number of spindle-shaped bodies, which after the rupture of the capsule are set free in the body of the mosquito. From there they pass, probably by the blood-stream, into the salivary glands which communicate with the base of the mosquito's proboscis by a long duct. The spindle-shaped bodies, or sporozoites, are introduced into the blood of a patient through the duct and proboscis by the action of the mosquito in biting, and then penetrate the red blood corpuscles and develop into one or other of the malarial parasites of the types already described.

Home Prophylaxis.—This consists, in the main, in household and personal cleanliness, in seeing that there is no standing water in the neighbourhood of the house, either on the ground or in vessels, and in the scrupulous use of

mosquito-netting and avoidance of infected areas—in other words, in doing everything to avoid being bitten by mosquitoes and to prevent the breeding of mosquitoes near the house. The native quarters of insanitary towns and in the country should be avoided, especially in the dusk and dark, as the mosquito is most active at these times. Houses made mosquito-proof by having mosquito-netting over doors and windows, are being frequently used in malarious districts, and steamships are being rendered proof in a similar way. At the same time, residents in malarious districts are well advised to avoid the evening and morning chill, which is a predisposing cause in malarial infection, and the use of quinine as a prophylactic is to be encouraged. From three to five grains of the bi-hydrochloride should be taken daily in the morning, or ten grains twice a week, or fifteen grains every ten or eleven days. Each method has its advocates, but the small daily dose is probably the best. People who show intolerance of quinine should not go to malarious countries.

Public Health Administration.—The duties of the medical officer in malarious districts are to educate his people in the "mosquito-malarial theory," to distribute quinine among those too poor to buy it and to take measures to eradicate the mosquito. Each one of these duties is important. It has been shown in British Colonies that the belief in the mosquito-malarial theory on the part of the governor has been half the battle in freeing a district from malaria, while an obstinate and unbelieving set of officials have made the efforts of the medical officer of no avail. The distribution of quinine among the poorer people tends to lessen the field of infection for the mosquito, which is a result of some value. The war against the mosquito resolves itself into draining swamps as far as possible, either directly, or by planting large trees of the "blue-gum" type, and in removing all pools and standing water collected in such disused vessels as tins, broken pots, &c. When pools cannot be drained and filled up, as in the residual pools in river-beds, it is enough to cover their surface weekly with petroleum, which prevents the mosquito from settling to deposit the ova, and asphyxiates the larvæ which have already hatched in the pools and which must come to the surface to breathe.

Chapter VIII.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.

Synonyms.—Spotted fever; Epidemic cerebro-spinal fever.
Fr.: Méningite cérébro-spinale épidémique.
Ger.: Epidemische Genickstarre.

Definition.—An acute infectious fever, associated with an inflammation of the cerebral and spinal meninges due to an infection by the *Diplococcus meningitidis intracellularis* discovered by Weichselbaum in 1888.

Incubation Period.—The incubation period seems to vary from one to twenty-eight days, but the usual latent period is apparently about two to ten days, although it is extremely difficult to be accurate on this point.

Rash.—Although the name "spotted fever" has been given to epidemic cerebro-spinal meningitis, the hæmorrhagic eruption which apparently gave rise to the name has been seen comparatively infrequently during recent epidemics. Billings of New York states that it occurred in only 10 per cent. of the cases which he analysed, Claude Baker gives 22 as his percentage, while in Glasgow, during 1906 and 1907 the percentage of cases in which the petechial rash appeared was 10.9 in 1906 and 21 in 1907, giving an average percentage of 15.95. The eruption appears usually somewhere between the first and fifth days of illness, most commonly on the third or fourth. Its duration is short, only three or four days elapsing between the appearance of the petechiæ and their

fading. The rash has a very generalised distribution, but may be more profuse over the lower part of the abdomen, and inner side of the thighs. It is composed of small hæmorrhages into the skin, of a bright purple colour, varying in size usually between a pin's head and $\frac{1}{4}$ of an inch in diameter, although it is not uncommon to find spots of the size of a shilling and even larger. Hæmorrhages into the conjunctivæ are occasionally seen. A similar eruption to this appears sometimes just before death.

The occurrence of a hæmorrhagic eruption is a very ominous sign. During the Glasgow epidemic of 1906 and 1907 only one case which had hæmorrhages into the skin recovered, and in this case fever lasted for 160 days, while recovery took place with complete deafness. In a few cases a mottling of the skin like the subcuticular mottling of typhus has been noted, both apart from and in conjunction with the petechial rash.

An herpetic eruption distributed about the angles of the mouth, on the cheek, the ears, or alæ of the nose, appears with just about the same frequency as the petechial rash with which it is sometimes associated. It usually makes its appearance on the second or third day of illness, but may be deferred until the second week. In some cases it makes its first appearance at the beginning of a relapse, and in others when it has appeared at the beginning of the attack it reappears when a relapse occurs. A blotchy erythematous eruption of quite irregular distribution is sometimes met with, and Osler mentions a deep livid erythema accompanied by blood-filled vesicles as occurring occasionally on the extremities.

Clinical Types.—The onset of the disease is sudden, and in most cases the attack is ushered in by the sudden occurrence of headache and vomiting, sometimes accompanied by rigor, or in children by convulsions. Extreme vertigo has been observed as a symptom of onset. In some cases the acute symptoms may be preceded by a few days of general malaise, or sore throat, or, very occasionally, of nasal catarrh. Shortly after the occurrence of the initial symptoms the patient may complain of stiffness and pain in the neck, and retraction of

the head may be noticed even in patients who are still able to walk about. The *temperature* is usually elevated from the start, but may fall to normal within the first day, although it is common to have a certain amount of fever present throughout the attack. It follows no regular curve, and the height of the fever is no measure of the severity of the attack. In some cases it rises rapidly to 105° F. or more just before death, but in many of the most acute cases death occurs during the first week with a normal or subnormal temperature. In a large number of cases the fever tends to be high during the first week and "continued" in type, while during the second week it takes on a marked remittent type which may end abruptly, or gradually terminate by a prolonged lysis. *The pulse* is usually increased in frequency, but in some cases its rate may be as low as 40 or 50 per minute, and it is common to have extraordinary daily variations in the same patient, having little apparent connection with variations in the temperature. Before death the pulse becomes rapid and feeble and may be very irregular, and in the more chronic cases it is usually rapid, irregular and indicative of low pressure.

In general, the disease presents acute, chronic and mild types.

The *acute type* is characterised by severe initial symptoms. Pain in the head, neck and back is complained of, especially on movement, Kernig's sign is frequently present and delirium, with more or less coma, develops within the first twenty-four hours. The face is flushed and may be very dusky, with suffusion of the conjunctivæ, while the patient has an anxious, suffering look.

In young children there is frequently a tendency to slight aching in the back, but pronounced opisthotonos is not seen until the more chronic stage is reached. The knee-jerks are frequently exaggerated before the onset of coma, and the plantar reflex is exaggerated but definitely flexor in type. The patient is often markedly hyperæsthetic, shrinks and becomes restless on even light handling, while photophobia is often present. The condition of the pupils is very variable. If delirium is present they are usually contracted, if coma,

dilated. They are frequently irregular, and a degree of *hippus* is sometimes present. A variable degree of squint is very common. In acute cases death occurs within the first fourteen days, not uncommonly on the fourth or fifth day.

The chronic type has an onset and early course similar to the acute, but death does not occur during the first fortnight. Instead, there comes an abatement of the more acute symptoms of pain, delirium and coma, but convalescence does not begin. There may be no fever, and when it is present it is usually very irregular in type. Opisthotonos may be marked, and a progressive wasting sets in. In some cases the degree of emaciation is quite extraordinary, and this remarkable degree of wasting is one of the most notable features in all cases which belong to the chronic type. Rigidity of the limbs is a very common symptom, and may be either transient or persistent. Vomiting is another symptom that is at times very distressing, although it may not interfere with appetite, which is usually good.

Twitching of the face and limbs, and marked muscular tremor are often observed. The patient may become completely deaf, and there may be some otitis media. A hyperæmia of the optic disc has been observed in certain cases, but none of those which recovered during the Glasgow epidemics were blind. As the disease proceeds the patient after a tedious period of wasting and enfeeblement may slowly recover, gradually losing his headache and rigidity and tendency to vomit, but after the passing away of all symptoms he may be unable to walk for weeks. His mental condition is often much enfeebled, and many who recover are permanently deaf. Many suffer for long from paresis of various groups of muscles. Death may occur after a prolonged illness of many weeks from sheer asthenia and progressive wasting, or it may be ushered in by the occurrence of violent convulsions.

The mild type of the disease is one where the onset is quite characteristic, but where there is no delirium or coma, although retraction of the head and even opisthotonos may be present. Such cases usually recover after a more or less chronic course without any of the more serious occurrences, such as wasting, deafness or paresis.

The abortive type is a name which may be given to a class of case where, although the onset is severe and acute, the disease terminates favourably within the first week or ten days, with rapid subsidence of all the symptoms and none of the dreary happenings of the chronic type.

Relapses are not uncommon, and may be very numerous, as many as a dozen having been observed. The relapses are not usually as severe as the initial attack, and each succeeding relapse tends to be milder than its predecessor.

Complications. — The only occurrence during the course of cerebro-spinal fever which may be classed as a complication is the occurrence of chronic hydrocephalus. This is met with not infrequently, appearing somewhere about the third week. The condition is indicated by an enlargement of the head, all the more striking when compared with the emaciated face. The eyes have a fixed staring look, and there is a tendency to retractation of the upper eye-lid. Nystagmus and hippus may be present, and optic neuritis is always found.

The hypostatic congestion of the lungs which sometimes occurs in chronic cases can scarcely be described as a complication, as it is due to the failure of the heart which is so marked a feature in such cases.

Sequelae. — Many of the cases which recover are deaf and mentally deficient. The mental deficiency may in some instances become less noticeable as health is established, but the deafness is always permanent. A very marked degree of muscular weakness is present for a long time in such cases as survive a chronic attack, but this is not a marked feature in those whose attack has been abortive.

Diagnosis. — Apart from association and the occurrence of the petechial rash there is nothing to distinguish an attack of epidemic cerebro-spinal meningitis from any other acute meningitis affecting the posterior basal region and the spinal cord, and only the course of the case may arouse suspicion. A fulminant case of typhus may closely simulate a case of cerebro-spinal meningitis, although it is unusual to have headache persisting through delirium in any condition other than a meningeal inflammation. Accurate and early

diagnosis must depend on the result of the examination of the cerebro-spinal fluid, and the importance of this examination cannot be too much emphasised, especially as in the early stages treatment by serum may offer some hope. In every case in which meningitis is suspected, the cerebro-spinal fluid should be examined by lumbar puncture without delay. Puncture is usually made in the space between the third and fourth or between the fourth and fifth lumbar vertebræ, the landmark being the line drawn between the summits of the crests of the iliac bones. In this region nothing is likely to be injured by the needle save a cord of the cauda equina. A needle of some four or five inches long with a large bore similar to those used with serum syringes should be used for the purpose. The patient may sit up, if he is able, or he may lie on his side. The back should be flexed as much as possible, and if the patient is delirious it may be necessary to have the assistance of two or three attendants to hold him in position. Lumbar puncture in cases of tabes dorsalis and general paralysis is performed easily after freezing the part to be punctured by means of the ethyl-chloride spray, but on account of the hyperæsthesia present in cerebro-spinal meningitis the process of freezing is usually as painful as puncture, and it may be necessary to give a general anæsthetic before the operation can be performed with safety. A little chloroform is well borne. In the case of an adult who is not very restless, it may be enough to administer $\frac{1}{4}$ gr. of morphine hypodermically a short time before puncture is made. In young children the interspace selected may be punctured in the middle line, but in older children and in adults it is best to introduce the needle about $\frac{3}{8}$ in. to $\frac{1}{2}$ in. to the right or left of the middle line, between the laminæ, and give the needle an inward and upward inclination. The needle should be introduced firmly and slowly, carefully avoiding bone, until the fluid flows. The depth to which the needle must penetrate varies from $1\frac{1}{2}$ inches in a young child to some three or four inches in an adult. In cerebro-spinal meningitis the fluid most commonly spurts out with considerable force, on account of increased pressure in the subarachnoid space, but it may flow only in drops. The fluid should be caught in a

sterile tube stoppered by sterile cotton-wool, and set aside for future examination. The needle should then be withdrawn, and the puncture sealed with a little sterile gauze and collodion. The skin should be carefully cleaned and the needle boiled before puncture. Soap and water followed by an application of acetone may be used to cleanse the skin. A very purulent and sticky exudate may refuse to flow through the needle even when it is undoubtedly in the subarachnoid space, and when fluid does flow, the quantity obtainable varies very much. Sometimes a few cubic centimetres is all that can be obtained, while at others as much as 50 or 60 cubic centimetres are obtained with ease.

A very few cubic centimetres is enough for bacteriological examination, and it is only when lumbar puncture is used for therapeutic as well as diagnostic purposes that a large amount is withdrawn. The fluid during the acute stage of an attack is always more or less turbid, but this turbidity varies from a mere cloudiness to a thick purulent exudate. For bacteriological examination the fluid should be centrifugalised and smear-preparations and cultures on ascitic agar made from the sediment. The smear-preparations should be stained by Jenner's method and examined microscopically. The cellular elements in the cerebro-spinal fluid in a case of epidemic cerebro-spinal meningitis are mainly polymorphoneuclear, as in the acute stage of all meningitis, whether of tubercular or pyogenic origin, and the differentiation depends on the recognition of Weichselbaum's *diplococcus intracellularis*. As the name implies, this diplococcus is found in the protoplasm of the polymorphoneuclear leukocytes, but it is also found in considerable numbers free in the fluid. Morphologically it presents the appearance of two small bean-like cocci lying with their concave sides towards each other, closely resembling the gonococcus. The polymorphoneuclear leukocytes are usually somewhat degenerated and may show marked vacuolation. When puncture is made during the chronic stage, the fluid may be quite clear, but in contrast to the clear fluid obtained in cases of tuberculous meningitis, the cellular elements continue to be polymorphic and not lymphocytic.

Agglutination of the *diplococcus intracellularis* from culture by the blood serum of a patient suffering from cerebro-spinal meningitis has been shown to take place, but this reaction is not always present and, indeed, is seldom present in the very early days of the disease, so that its use is confined to the recognition of cases which come under observation after having been ill for some time. A disadvantage of the reaction as a test is that it is obtained with great variability in even moderately high dilutions, and a dilution of only 1-3 or 1-5 must be employed to obtain it with any certainty.

The *opsonic index* of the patient to the *diplococcus intracellularis* is usually raised and may be very high.

Treatment.—Apart from the giving of antitoxic serum, the treatment of cerebro-spinal meningitis must be purely symptomatic and palliative. It will be necessary to relieve pain, lessen restlessness and control delirium during the acute manifestations and to maintain strength during the chronic stage. Morphine in small doses hypodermically will quiet restlessness, relieve pain and induce sleep, but it has been observed that after its use patients tend to become comatose, and many physicians prefer to use small doses of chloral hydrate in combination with sodium bromide, repeated at frequent intervals, to quiet the patient, and to rely on other methods for the relief of pain. Cold applications to the neck and spine have been advocated when pain is severe, but the majority of cases so resent cold that the applications can be made only for very short periods and are quite ineffectual. Claude Ker, of Edinburgh, advocates the use of a hot bath when patients are restless and in pain, and his experience is that after a bath a patient may get some hours' sleep and freedom from pain. This method of treatment is possible in a private house as in hospital. Several baths should be given in the course of the day, and each bath should be of about half-an-hour's duration.

But the death-rate shows how futile palliative treatment is in the case of cerebro-spinal meningitis, and one must look to some form of serum-therapy to make treatment at all hopeful. Anti-meningococcal serum has been made by Kolle and Wassermann, Ruppel, and Burroughs, Wellcome & Co., and

all these sera were used in Belvidere Hospital, Glasgow, between May, 1906, and May, 1908, and the result of treatment recorded by Currie and Macgregor in "The Lancet" in October, 1908. The sera were given subcutaneously, intravenously and intrathecally, but the results following on their use were not very encouraging, the death-rate all over being 74.8 per cent. Gardiner Robb published in 1909 the results of his experience with Flexner's serum in Belfast, and the apparent reduction of the death-rate in that city from 70 to 30 per cent. would seem to offer some hope that serum-therapy properly used may afford a weapon of some power to fight this most deadly disease. But it must be remembered in comparing the results of one man in one place with those of another man in a different place, that the type of epidemic in the first place may have been quite different from that in the second, and it is only after the careful study of the results obtained by the same serum in many different epidemics that we can properly arrive at its true value. Serum ought always to be given intrathecally. Lumbar puncture should be made, as much fluid withdrawn as will flow naturally, and at least as much serum injected. When the fluid is thick and purulent it is well to wash the cavity with sterile saline solution to remove as much pus as possible before the introduction of the serum. As much as 40 cubic centimetres may be injected at a time, unless great restlessness and headache on the part of the patient shows that the pressure in the subarachnoid space is too high. The injection may be repeated daily or even oftener until the subsidence of symptoms.

McKenzie and Martin published in the Journal of Pathology and Bacteriology, 1908, the results of their investigations on the cerebro-spinal fluid. They showed that the cerebro-spinal fluid did not contain certain substances which were bactericidal to the meningococcus outside the body, although such substances were present in the blood-serum of the same patient. They accordingly injected into the subarachnoid space serum from the blood of other patients or, in some cases, of the patient himself, to supply the deficiency, and the results seem to warrant the employment of such

treatment, at least where there is difficulty or delay in the procuring of a suitable antitoxic serum.

The mere aspiration of cerebro-spinal fluid is at times attended by temporary relief to the patient, and continuous drainage of the subarachnoid space has been tried in some cases, but the results of any form of treatment other than serum therapy offer but little hope for the amelioration or cure of the disease.

Treatment of Sequelae. — The troublesome muscular weakness which is so usually present in cases who recover from cerebro-spinal meningitis is best treated by massage and mild galvanism, while the general condition of the patient may be improved by the use of iron, arsenic and strychnine. A good combination for older children and adults is that of Ferri et Ammon. Cit. grs. v-x, Liquor, Arsenicalis m. ii-v, and Liquor. Strychnini m. iii-v, given thrice daily after food. In young children, nothing is better than Extract of Malt and Syr. Ferri Phosph. Co. in suitable doses according to the patient's age. In cases who have become convalescent, the greatest care must be taken in allowing them to resume work after their illness. It is wise to forbid a child to attend school for some six months after recovery is apparently complete, and all adults who are engaged in work involving mental strain should have a corresponding holiday of three months when at all possible. Children who show any signs of weakness of mind after recovery ought to be kept very quiet and free from strain until long after all signs of intellectual weakness disappear.

Epidemiology. — Sporadic cases of epidemic cerebro-spinal meningitis are frequently met with in many parts of the British Islands and America, but of recent years epidemics of considerable gravity have occurred in Glasgow, Edinburgh, Belfast, the United States, and various parts of Germany. An epidemic tends to decline during the warmer months of the year and to show exacerbation during the winter and spring.

Method of Infection. — While it is beyond doubt that the infecting organism in epidemic cerebro-spinal meningitis is the diplococcus intracellularis of Weichselbaum, it is by no

means so certain how this organism gains entry into the human body, and how infection is conveyed from an infected person to another. It is probable that the organism enters by the nasal passages and tonsils, but study of the throats of patients suffering from epidemic cerebro-spinal meningitis has not revealed the presence of the organism, and it is quite possible that the disease is carried from person to person by people who are not yet themselves the victims of the disease and may never become so, whose nasal and buccal discharges may contain the organism in abundance, but who are themselves apparently healthy.

In studying the period of incubation of cerebro-spinal meningitis one is struck by the fact that while two members of a household may fall ill within twenty-four hours, other members of the household may escape entirely, indicating rather that the two who were attacked by the disease had been infected from a common source, than that one took the disease from the other. The disease is not easily transmitted from the sick person to those surrounding him, as is shown by the fact that it is nursed with safety in the wards of general hospitals, but it seems likely that in the dirt and dust of houses, in unclean streets and back courts, the infecting organism may flourish and spread the disease, in some instances very widely.

Period of Infectivity.— A patient who has suffered from epidemic cerebro-spinal meningitis is probably not infectious beyond the establishment of convalescence, and it is safe to allow him to mix with his fellows as soon as his strength permits him to be up and doing.

Death-Rate.—The death-rate has varied very much in different epidemics. In certain extremely limited outbreaks it has been recorded as between 4 per cent. and 27 per cent., but in larger epidemics it has varied between 41 per cent. and 75 per cent. During the Glasgow epidemic between May, 1906, and May, 1908, the death-rate was 74.8 per cent., one of the highest recorded.

Home Prophylaxis.— Beyond the general precautions taken in the isolation and care of patients suffering from any one of the infectious fevers as indicated in the introductory

chapter, little need be done. It is the practice of many physicians to recommend the daily irrigation of the nasal passages with a solution of sodium salicylate in water, grs. x to the ounce, and the washing of the throat with the same solution night and morning during such times as the disease may be prevalent, and there is much to be said in favour of this practice among dwellers in towns, where a little chronic inflammation of nose and throat is so common, and the defensive power of the tonsils and nasal mucous membrane thereby impaired. The general health of all children during an epidemic should be very strictly attended to.

Public Health Administration.—All cases occurring in insanitary districts should be removed to hospital, and the houses in which cases have occurred must be thoroughly disinfected either on the removal of the cases to hospital or on their convalescence if nursed at home. All bedding, clothing and furniture which has been in contact with the patient should be dealt with either by steam or by formalin solution, the walls of the house, the floors, lobbies and back yards connected with the house should be washed with formalin, and all ashpits and ashbuckets should be cleaned with chloride of lime solution. In view of the possibility of the disease being spread by expectoration, notices intimating this fact ought to be posted in districts where the disease is occurring, and the streets and pavements, public stairs and entries should be washed at least once a day with water charged with permanganate of potash or some other suitable disinfectant. Faulty drainage systems must be corrected and the necessity for public and personal cleanliness insisted on.

Chapter IX.

ANTHRAX.

Synonyms. — Splenic Fever; Malignant Pustule; Woolsorters' Disease.

Fr.: Charbon; Mal de Rate.

Ger.: Milzbrand.

Definition. — An acute infectious fever, characterised usually by an external lesion of skin or mucous membrane, and possibly a subsequent generalised blood infection with enlargement of the spleen, but sometimes primarily septicæmic without visible external lesion. It is caused by a micro-organism, the Bacillus Anthracis, first described as conveying the specific infection of the disease by Davaine, in 1863. The name Bacillus Anthracis was given to it by Cohn, and the fact that it contained spores was first demonstrated by Koch.

Rash.—No rash has been described as typical of the disease.

Incubation Period.—This is, as a rule, only possible of estimation when the disease begins with a local affection of skin or mucous membrane, and even then may be difficult to determine with any degree of accuracy. It is usual to say that the incubation-period may vary from a few hours to some ten days.

Clinical Types. — The three forms in which the disease is met with commonly in man are malignant pustule, gastro-intestinal anthrax, and pulmonary anthrax.

Malignant Pustule, the *charbon* of French writers, appears as a vesicle set in a browny and inflamed base, usually produced by the inoculation of some scratch or slight wound of the skin or mucous membrane, and is situated on the face,

angle of the mouth, lip, buccal mucous membrane, the neck, hand or forearm or any exposed part. A slight pricking and burning sensation is first felt by the patient in the infected part and a papule soon appears on which forms a clear vesicle, sometimes of considerable size. The vesicle ruptures and dries up, forming a dark almost black scab. Round this central scab a ring of closely-set vesicles frequently forms. The base of the vesicles becomes dark and indurated, and a deep red or purple areola forms round it, while a brawny œdema quickly spreads in the adjoining tissues. Sometimes there is marked inflammation of the lymph channels, and the neighbouring lymphatic glands may become enlarged and tender. The time elapsing between the appearance of the vesicle and the formation of the typical pustule with its dark centre, hard base, deep red areola and surrounding œdema is usually about two days, and during this time the general health of the patient may not be affected, save by a feeling of slight malaise. At the end of that time, however, the temperature rises, and the patient suffers from headache and varying degrees of prostration, pain in the limbs and sweating. Delirium may be present and death from an acute septicæmia with collapse may occur about the fifth to eighth day of illness. In other cases a spread of the infection to the lungs, intestine or brain takes place, and the patient may die with the signs of a rapid pneumonia, violent abdominal pain, diarrhœa, and vomiting, or the symptoms of serious cerebral trouble—headache, delirium, restlessness and ultimately coma. As the symptoms become general the spleen usually enlarges so that it is palpable below the costal margins.

In rare instances the pustule proceeds to spontaneous cure—the central part sloughs out, the surrounding induration disappears, and the ulcer which remains heals somewhat slowly. But in the great majority of cases where the pustule is allowed to develop without surgical interference, symptoms of general septicæmia supervene and the patient dies.

Intestinal anthrax is a rare condition, even when it follows on a malignant pustule, and is practically invariably fatal. It is not likely to be diagnosed during life, as its symptoms are simply those of a profound gastro-enteritis with

marked general symptoms of toxæmia. Vomiting and diarrhœa set in after a short time of malaise, headache, anorexia, and pain in the back and limbs. The evacuations frequently contain blood. Dyspnœa and cyanosis make their appearance early and the patient may be either mildly delirious or stuporose. Convulsions may occur, of an epileptiform type, and there may be some tetanoid spasm of the arms. Fever may not be high, and death is ushered in by extreme collapse. The duration of this type of the disease is from a few hours to about a week.

Pulmonary Anthrax, like the intestinal form of the disease, may occur either as a primary condition or as the sequel of a malignant pustule. It is not quite so fatal as the intestinal form. The symptoms of onset are prostration and a sense of great oppression in the chest. Respiration is not commonly rapid, but is laboured and difficult. Cough is present, and may or may not be accompanied by expectoration, which is usually profuse and blood-stained. Physical examination of the lungs reveals little but generalised rhonchi, and some moist crepitation at the bases. The face is cyanosed, and the extremities are usually cold and blue. The temperature is elevated in the rectum, although in the axilla or groin it may be subnormal. The pulse is rapid, of low pressure, and may be markedly irregular. Death may be preceded by delirium or coma, or the patient may be quite conscious to the end, which comes suddenly with rapid cardiac failure. Such cases are usually fatal within five days, sometimes within the first twenty-four hours, and if a patient survives for a week, it is said that he has a chance of recovery.

Other forms are those where the symptoms are entirely cerebro-spinal, and the patient may suffer from what appears to be acute meningitis, with vomiting, headache, irregular respiration and pulse-rate, delirium and headache, or coma, sometimes a little retraction of the head and even episthotonos. In another class of case the patient may present no symptoms referable to any organ, and merely show signs of a profound toxæmia with fever and delirium or coma. In this last class of case the spleen may be enlarged. Such irregular forms of the disease are always fatal.

Diagnosis.—There is little difficulty in the diagnosis of a typical malignant pustule where a central scab and ring of vesicles are present set in a hard reddened base with surrounding brawny œdema, but even when this is present it is well to try to establish the diagnosis by a search for the bacillus of anthrax. As a rule it is easily recovered from the ring of vesicles or the base of the pustule by incision, and the making of a smear-preparation of the exuding fluid, but if the pustule has sloughed considerably it is often impossible to obtain recognisable forms of the organism. The appearance of the organism is very typical—long thick bacilli with rather squared ends showing in many instances evidence of spore-formation in the shape of clear oval spaces interrupting the stained protoplasm of the organism. In cases where much sloughing of the pustule has taken place the bacilli may be unrecognisable from degeneration and the only indication of the infecting organism may be the presence of ill-stained oval bodies suggestive of spores. Under these circumstances it is necessary to make a culture from the remains of the vesicles and from the reddened area after incision, and if the organism or its spores are present a growth should be obtainable on agar after twenty-four hours' incubation at 37° C. The bacillus stains well with ordinary basic anilin dyes, and gentian violet is a convenient and rapid stain. In cases of primary cerebral, septicæmic, intestinal and pulmonary anthrax the recovery of the bacillus is the only means of arriving at a correct diagnosis. In the majority of such cases the bacillus may be recovered from the peripheral blood-stream, either by the direct examination of smear-preparations, by incubation of 5 or 10 cubic centimetres of blood in peptone bouillon at 37° C., or by injecting a few cubic centimetres of blood into some susceptible animal such as a rabbit or guinea-pig.

The bacillus can usually be recovered from the spleen by puncture in cases where the symptoms are general and severe, but as the anthrax spleen is soft, this is not a practice to be recommended. Puncture of the spleen by a Pasteur's pipette is a method useful for the recovery of the bacillus when a patient has died with symptoms resembling a general infection with anthrax, and under circumstances where there was a possibility of such infection occurring.

In arriving at a presumptive diagnosis of anthrax, the occupation of the patient must always be considered, remembering that butchers, cattlemen, shepherds, wool-sorters and workers in horse-hair are those most likely to be exposed to infection by the B. Anthracis.

Treatment.—Where there is any visible external lesion it should be freely excised, and the resulting wound swabbed with pure carbolic acid or a strong solution of caustic potash, or the actual cautery may be applied freely to the raw surfaces. In some countries the malignant pustule is destroyed by the actual cautery or caustic potash without incision. The practice of filling the wound with powdered ipecacuanha after excision of the pustule has been attended with good results. The success of surgical treatment depends largely on the stage at which the disease is encountered. If the pustule is in an early stage, before there are any constitutional symptoms, excision offers considerable hope for the patient's recovery, especially if the pustule be situated on the hand, arm or leg. When it is situated on the neck, there is more chance of the early involvement of lymphatic glands than if it were situated at more distant parts, and excision offers less hope of cure, while there is always danger of the œdema of the surrounding tissues causing suffocation either from pressure on the trachea, or from actual spread to the epiglottis or larynx. If it be situated on the face, angle of the mouth, lip, or buccal mucous membrane, the chance of preventing a general infection by excision of the local focus is much more remote, indeed, in certain situations, e.g., the buccal mucous membrane or the eyelid, excision is extremely difficult. When the infection is general, whether primarily so or secondary to a malignant pustule, the patient generally dies, although certain cases of the pulmonary variety who have survived the first week of illness have been known to recover. Beyond surgical interference, where serum is not used, treatment must be purely palliative and consists in relieving pain and subduing restlessness by the use of morphine hypodermically or some preparation of opium by the mouth, and in stimulating the patient when there is any indication of collapse or cardiac failure by the use of alcohol and hot applications on the heart. Where signs of cardiac failure have declared

themselves the condition is so hopeless that treatment is carried out rather from a sense of duty than from any hope of good result.

Within recent years, however, Sclavo of Siena has prepared an anti-anthrax serum obtained by immunising asses. This serum is not as accurately standardised as antidiphtheritic serum, but its immunising powers are tested on rabbits before it is put into circulation. Sclavo uses the serum alone in his treatment of anthrax cases, and this is the more general practice in Italy, but in England it has been used in combination with local treatment of the pustule. The dosage should be large, 50 cubic centimetres as a first dose, and 40 cubic centimetres on each succeeding day for two or three days, until the symptoms have abated. Sometimes a single dose is sufficient, and the number of doses necessary will depend on the severity of the case. It is of the utmost importance that this treatment should be begun as early in the course of the disease as possible. The results of serum therapy are very encouraging. Legge's views are to be found in the report of the Milroy lecture, 1905, in the British Medical Journal for March 18th of that year. He analyses 67 cases, of which 56 were treated with serum alone, and out of these 67 cases only two died. In 1903 Sclavo reported his results in 167 cases when he had a case-mortality of only 6.09 per cent., at a time when the mortality in the rest of Italy was 24.1 per cent. The serum seems to be quite innocuous even in large doses, and is well borne when injected into a vein. From the cases reported it would seem that no case of moderate severity need die if serum is used in the early stages, while many cases which looked hopeless were cured by the use of the serum, even when the situation of the pustule made excision impossible. One of the advantages of the early use of serum is that it prevents loss of tissue from sloughing of the pustule in a marked degree. In the intestinal, pulmonary and cerebral types of the disease, or in any case where the bacilli are found in the blood stream or which seems of considerable gravity, the serum should be given intravenously, and, indeed, intravenous administration of serum is the only form of treatment which offers the slightest hope of the cure of such cases.

When patients suffering from malignant pustule have been treated with the serum, their convalescence is usually strikingly rapid and complete.

Epidemiology.—Anthrax is primarily a disease of horses, sheep, cattle, deer and goats, and is met with practically in every part of the world. In the United States and Australia it is rare, and while it is comparatively common in Great Britain, it does not occur in this country with anything like the same frequency as it occurs among the susceptible animals in France, Germany, Russia, Italy, Turkey, Asia, South America and in some of the Northern parts of Africa. Pastures become infected so that new flocks or herds arriving there contract the disease, and may in their turn infect other pastures by their discharges. The infection of fields has been known to result from the scattering over them of infective refuse from factories or the carrying of infective material from workshops to them by floods. Anthrax may be carried from animal to animal by blood-sucking flies.

Method of Infection in Man.—Anthrax is always transmitted to man by contact, direct or indirect, with infected animals. Shepherds, cattlemen, butchers and men employed in slaughter-houses become infected through some abrasion of their skin. I recollect one case in a man who, suspecting tuberculosis in a cow which had died mysteriously, made an opening into the thorax through which he introduced his arm to examine the pleura for nodules. He was conscious at the time that he grazed his forearm on a rib, and a few days afterwards noticed that the scratch was inflamed and itchy. A typical malignant pustule developed which was removed, and the man recovered.

Tanners and woolsorters are frequently infected by hides and wool imported from infected districts. Those who work with horsehair in the making of mattresses, furniture and saddles are also liable to become infected from imported hair. Siberian horse-hair is particularly dangerous in this respect, and its importation is discouraged in Great Britain. There is nothing which shows the extraordinary powers of resistance of the anthrax spores more than the fact that girls sometimes contract anthrax who are employed in the stuffing

of mattresses and furniture with black horse-hair which has been previously curled by heat and dyed by chemical processes. Tanners, butchers, shepherds and cattlemen commonly contract the external form of the disease; woolsorters are more liable to the internal forms, from the inhalation or swallowing of infective dust, while workers in horse-hair contract both, the internal form rather predominating.

There is no doubt that sometimes the infection is conveyed to man by the bites of insects, while the source of infection in a few cases seems to have been infected meat which had been eaten.

Period of Infectivity.—It is safe to assume that when convalescence is established there is no longer any danger of the patient being infectious. It is probable that the bodies of men and animals who have died of the disease remain infective for a long time, and the careless disposal of these may help to spread the infection.

Death-Rate.—This varies greatly with the types of the disease. In the external forms, which have been treated by excision or cautery, or both, the death-rate, when the pustule is situated on the extremities, is probably between five and ten per cent.; when it is situated on the face or neck, about 25 per cent. Of the internal forms, the cerebral and intestinal types are practically always fatal, and the death rate in the pulmonary type is probably between 70 and 80 per cent.

Home Prophylaxis.—For workers among wool and hair, butchers, shepherds and tanners it is of the greatest importance that the hands should be thoroughly cleaned after work, and the slightest abrasion of the skin on the exposed parts of the body should be treated antiseptically and sealed. Those in attendance upon anthrax cases ought to observe carefully the same precautions, and must remember that the sputum in the pulmonary type and the motions in the intestinal type are probably highly infective, should be handled with the greatest care, and must be disposed of by burning or by mixing with an equal quantity of a 1 in 500 solution of perchloride of mercury or a strong formalin solution, and allowed to stand for some hours before being allowed to pass into the drains. All dressings should be burnt as soon as they are taken off, and

bedclothes should be frequently changed and immersed in a 1 in 500 solution of perchloride of mercury or strong solution of formalin before being boiled previous to washing. If the patient is nursed at home he should be isolated as strictly as possible.

Public Health Administration.—When a case of anthrax has occurred in man the Home Office must be formally notified by the usual certificate, and the local authority warned of its occurrence. The source of infection must be investigated, and if it be found that the infection has been introduced by wool, hair or hides, the suspected consignment ought to be destroyed, the place from which they come notified, and the condition of sheep, cattle, and horses in that district investigated. In the case of repeated infected consignments coming from the same district abroad, it may be necessary for a time to prohibit the importation of wool, hair or hides from that district. Similarly if the infection is due to diseased cattle or sheep in the case of butchers, workers in the slaughter-house, and shepherds, the strictest investigation must be made in the districts from which the cattle or sheep come and the source of the infection removed, whether it be infected pasture or buildings or unrecognised cases of anthrax among the flocks and herds. If the infected cattle or sheep have come from abroad, it may be necessary to exercise for some time a careful supervision of all consignments from the country which has supplied the diseased animals, and, if necessary, even to prohibit altogether further consignments from that country until evidence can be produced that there is little or no danger of diseased animals being again imported.

Disinfection of the houses, bedding, clothing and furniture which have been used by a patient seized with anthrax should be thoroughly carried out with strong formalin solutions, and the walls, floors, stairs and lobbies of the house where the case has occurred must be dealt with in the same way. It is to be remembered that although the bacillus itself is easily killed, its spores are extraordinarily resistant. It is best that the bodies of all cattle and human beings who have died of anthrax should be disposed of by cremation.

Chapter X.

GLANDERS.

Synonyms.—Farcy, Equinia, Malleus.

Fr.: La Morve, Le Farcin.

Ger.: Rotzkrankheit, Wurmkrankheit, Drüse.

Definition.—An acute infective disease characterised by granulomata affecting the mouth and nares (glanders), and the subcutaneous and muscular tissues (farcy), caused by a specific micro-organism, *Bacillus Mallei*, discovered by Schütz and Loeffler in 1882.

Rash.—In some cases there is a more or less generalised erythema, and a papulo-pustular eruption is among the typical manifestations of the disease.

Incubation Period.—This is difficult to determine accurately, and is probably very variable. It is usual to say that the incubation period is from five to fifteen days, but it is possible that this period may be exceeded.

Clinical Types.—Glanders in man, as in the horse, may follow an acute or chronic course, and some writers speak of acute and chronic glanders, meaning glanders primarily attacking the nose and the mucous membrane of the respiratory tract, and of acute and chronic farcy—glanders manifesting itself as nodules in the subcutaneous tissues which break down, and which are often associated with enlargement of the lymph-glands and, possibly, phlegmonous inflammations. There seems little use to confuse by the use of the term "farcy." In nasal cases the lesions are the same as the subcutaneous, rapidly forming granulomata that tend to break down, forming small abscesses and ulcers.

Acute Glanders.—The symptoms of invasion are those common to any acute febrile condition, and the patient complains of headache, general malaise, pains in the back and limbs, anorexia and nausea. Shortly after these premonitory symptoms, the temperature is raised, but it is not until some days later that the typical lesions make their appearance, and if these appear first in the nose, it may be some time before a diagnosis is arrived at. The mucous membrane of the nose becomes congested and invaded by nodules and the whole nose swells. The nodules break down rapidly and a purulent discharge comes from the nostrils. At the same time it is common to have an eruption of papules round the nose and mouth and over the face generally which quickly become pustular, after which they burst, leaving little superficial ulcers, or dry up to form scabs. Small patches of a purplish erythema are also seen, and on palpation they are found to overlie a small firm nodule, like an erythema nodosum, which is tender. The nodule enlarges, softens and breaks down, while the skin often shows bullæ which burst as the nodule softens, and with the breaking down of the nodule a ragged ulcer is formed. Similar nodules form deep in the muscles and also soften and break down while the skin over them inflames, gives way, and an ulcer forms. Hæmorrhages may occur into or around the nodules. A subacute pneumonia is frequently met with, and in some cases, after a short period of malaise, the initial illness may closely resemble an attack of acute lobar pneumonia, and it is not until the development of cutaneous lesions, either nodules or papules, some days later, that the true nature of the infection may be apparent.

In certain cases the formation of nodules may be associated with all the signs and symptoms in neighbouring large joints of a more or less acute arthritis—pain, tenderness and swelling round the joint and fluid effusion into the joint-cavity. The fluid is at first clear and serous, but after some days it becomes purulent. In one case mentioned by Goodall, suppuration did not take place for thirteen or fourteen days. Occasionally a subperiosteal abscess may form, either alone or in connection with a suppurating joint. Sometimes the first obvious lesion appears at what was probably the

site of inoculation in the skin. In such cases a phlegmonous inflammation arises at the probable site of inoculation and little swellings appear along the course of the lymphatics. These suppurate and there is also enlargement and possibly suppuration of the lymphatic glands. Pain and swelling of neighbouring joints occur but superficial lesions of the skin are not common.

The symptoms, beyond the symptoms of invasion, depend absolutely on the situation in which the first nodules appear. If in the nose, the disease will at first resemble an extraordinarily acute nasal catarrh; if in the muscles, the associated pain may resemble acute rheumatism; if in the lung, an attack of acute lobar pneumonia.

Chronic Glanders.—The chronic type of glanders presents symptoms and lesions similar to those met with in the acute type, but the course of the disease is slow and its manifestations less active. The period of invasion is prolonged, and a patient may suffer for weeks from malaise, headache, loss of appetite, slight fever, nasal catarrh, and pains in joints and muscles before the appearance of subcutaneous or intramuscular nodules. On examination, the nasal catarrh may be found to be associated with some ulceration of the mucous membrane, and an indolent ulceration may be present in the mouth. The subcutaneous and intramuscular nodules slowly soften and the more superficial form ragged, sluggish ulcers, while the deeper discharge through unhealthy sinuses. The ulcers and sinuses tend to heal and break down again, and this tendency is a notable feature in the disease. Cellulitis may result from infection of the chronic glanders sores by pyogenic organisms. It is to be remembered that, although the disease may be running a chronic course, an acute exacerbation may occur at any moment.

In some cases the disease may appear only as a chronic inflammation and ulceration of the larynx, trachea and bronchi, the patient suffering from hoarseness and cough, and a diagnosis of glanders may not be made unless an acute exacerbation of the disease occurs with the formation of the typical nodules in the skin and subcutaneous or muscular tissues.

Diagnosis.—Before the development of the typical lesions, glanders has been mistaken for *smallpox,* when the papular and pustular eruption on the face and body has been unusually profuse; for *enteric fever* when a prolonged pyrexia and mild pulmonary affection have been the chief features in the early part of the attack; for *acute lobar pneumonia* where consolidation and abscess formation in the lung with an herpetiform eruption about the nose and mouth have been the obvious lesions; and for *acute rheumatism* in those cases where pain in muscles and pain, swelling and effusion in a joint have preceded the appearance of deeply seated nodules in a limb. Where, as sometimes happens, the fever is markedly remittent or intermittent, the diagnosis of some obscure *septicæmia* or *pyæmia* has been made, and in cases where there is, at the beginning of an attack, a prolonged pyrexia without any obvious lesions, the case is frequently mistaken for *enteric fever* or *influenza.* In those acute cases which present marked signs of nasal ulceration the diagnosis is not usually difficult, as there is no other disease which produces such marked and rapid swelling of the whole nose and is associated with a papular eruption which rapidly becomes pustular, but it is to be remembered that marked nasal implication is not very common. Similarly when the primary lesion is in the mouth, its characters and its association with a papulo-pustular eruption on the face, make it unlikely to be mistaken for anything else. But both the papular stage and the pustular stage of the eruption may closely simulate smallpox, although the course of the disease and the eruption are very different in the two infections. In glanders, the eruption appears only after many days of premonitory symptoms, and is never vesicular, while in smallpox the papules appear on the third day of illness, and run through a definite course as vesicles before becoming pustules. In the type of glanders which may give rise to a diagnosis of acute rheumatism it is uncommon to find more than one joint affected, quite unlike the implication of one joint after another which is the rule in acute rheumatism, and if effusion into a joint does occur, it is almost certain to become purulent. The typical lesions in glanders, nodules which break down and form abscesses in the

subcutaneous tissue and in the muscles, serve to differentiate the disease from other conditions, even from enteric fever, where it is very unusual to have abscess formation until well on in the third week of illness, and in which abscess-formation is rather inter- than intra-muscular. Widal's test and the making of cultures from the blood will also help to differentiate the disease.

The occupation of the patient is a valuable aid to a presumptive diagnosis of glanders. It always occurs among those who are associated with horses, and it is well to suspect this disease in any one whose occupation or tastes bring him into close contact with the horse and who has developed an acute suppurative condition or an obscure febrile disorder whether associated or not with eruptive nasal catarrh, or the formation of cutaneous or intra-muscular nodules.

The ultimate diagnosis must be made on the recovery of the Bacillus Mallei from the lesions. The bacillus is short, straight or slightly curved, having rounded ends. It is best stained by carbolthionin-blue. It grows rapidly in any ordinary medium and is a facultative anærobe. In chronic cases of the nasal type, the bacillus may not grow on culture-media inoculated from the secretions of the nose, and it may be necessary to make an emulsion of the secretion in sterile salt-solution and inject it into the peritoneal cavity of a male guinea-pig, when, if the bacillus is present, an inflammation of the testicles and skin of the scrotum occurs, and death results in two or three weeks, with widespread glanders in the viscera.

Mallein, a fluid containing the active toxins of the bacillus, may be used as a test in obscure chronic cases, in the same way as tuberculin. If the patient suffers from glanders both a local and general reaction follow on the injection, if he is not suffering from glanders, no reaction follows.

Complications.—The rarer manifestations of the disease, such as subperiosteal abscess, pericarditis, and meningitis, may perhaps be best described as complications. The other complications are of the pyæmic and septicæmic kind which may arise from a secondary infection of the lesions by

pyogenic organisms—cellulitis, lymphangitis, suppuration of lymphatic glands, pyogenic broncho-pneumonia, &c.

Sequelæ.—In the few cases who recover no notable sequelæ as a rule occur except a prolonged physical and psychical enfeeblement due to the long and severe febrile illness.

Treatment.—The treatment of *acute glanders* in the human subject is very hopeless, since the signs which make the diagnosis possible do not appear until the disease has been active for many days. If a wound has been infected, it should be treated with the actual cautery as early as possible. Lugol's solution should be injected into the pustules and nodules, and some 40-50 cubic centimetres of bullock's serum may be injected subcutaneously or intravenously, on the ground that cattle, being immune to glanders, may have in their serum a substance naturally antagonistic to the bacillus mallei and its products. The general strength of the patient should be maintained by rest, careful feeding and stimulation, but the outlook is bad, and very few cases recover from this form of the disease.

In *chronic glanders* the skin lesions should be scraped, washed with Lugol's solution and packed with iodoform gauze. The nose should be washed out with a solution of boric acid, borax or permanganate of potash, and every visible ulcer ought to be touched with lactic acid or chloride of zinc. Repeated "malleinisation" may be practised as recommended by Babes, $\frac{1}{20}$th—$\frac{1}{10}$th of a cubic centimetre being injected every two or three days for some months if necessary. The patient must be put under the best possible surroundings as regards hygiene, rest and food.

Diet.—In *acute glanders* the patient must be given a fluid and semi-solid diet of as high a nutritive value as possible, and stimulants may be given freely.

In *chronic glanders* the diet should be liberal and sustaining, including eggs, fish, lightly cooked steak or chop, and roasted or boiled beef and mutton. Stout is a useful form of stimulant in such cases.

Epidemiology.—Glanders is primarily a disease of the horse, and is met with wherever horses are used, but especially in the larger towns. In the British Islands it appears

among the horses of London and Glasgow more than in any other districts. It is, however, a rare disease in man, and very few deaths are reported annually in the United Kingdom from this cause. It has been acquired in the laboratory, and may be communicated by one human being to another. It affects almost exclusively those who work among horses. The cases which appear are always isolated, and the disease never becomes epidemic in man.

Method of Infection.—It is probable that in many cases glanders is acquired through some small abrasion of the skin or mucous membrane, but it may also be acquired by the ingestion of infective material. It may be conveyed directly from the horse to man and from man to man, and also through the medium of stable litter.

Period of Infectivity.—In *acute glanders* the few cases which recover are probably not infectious after convalescence is thoroughly established, but in *chronic glanders* it is difficult to give a definite limit for the period of infectivity. It is, however, reasonable to suppose that after the complete healing of every accessible lesion the patient is no longer a danger to the community.

Death-Rate.—Upwards of 90 per cent. of all persons attacked with acute glanders die, and even in the chronic form of the disease the mortality is probably well over 50 per cent. It is usual to give a more favourable prognosis where the disease is limited in distribution, as when only the skin or one extremity happens to be affected. When the external lesions tend to heal the outlook is also more favourable.

Home Prophylaxis.—Cases of glanders whether acute or chronic should be strictly isolated and the usual precautions taken with body-clothing, bed-clothes and discharges. The local authority must be advised of the occurrence of any case. Those in attendance on the patient ought to be extremely careful to seal any abrasions on the skin which happen to be present, and ought to wash the hands and clean the nails most scrupulously after touching the patient. All those who work in stables ought to watch horses carefully for any signs suspicious of glanders and on the occurrence of such signs have

the animal tested with mallein by a competent veterinary surgeon.

Public Health Administration. — All cases of acute glanders should be removed at once to hospital, unless their homes are such as admit of the most complete isolation with good hygienic surroundings. Chronic cases may remain at home unless their houses are very small and dirty, in which case they also should be removed. The source of infection must be traced and all horses among which the patient was working examined and, if necessary, tested with mallein to establish a diagnosis of glanders when the horse is the subject of a chronic or latent type of the disease. The diseased horse, if worth the trouble, may be treated by repeated malleinisation; if not, it must be killed and the carcass destroyed. The stable must be cleaned, washed down with strong formalin solution, and kept under supervision by the veterinary authority for some months.

Chapter XI.

INFLUENZA.

Synonyms.—Epidemic Influenza; "the Russian Influenza."

Fr.: La Grippe.

Ger.: Grippe.

Definition.—An acute specific fever, characterised by pyrexia, pain in the back and limbs, headache, and disturbances of the gastro-intestinal tract, the heart, the respiratory tract and brain, due, probably, to the action of the *Bacillus Influenzæ* discovered by Pfeiffer in 1892.

Incubation Period.—The incubation period of influenza is very short, varying from one to three days.

Rash.—No rash has been observed as typical of the disease.

Clinical Types. — It is usual to describe attacks of influenza as conforming to one or other of five types, the *simple febrile*, the *catarrhal*, the *bronchitic*, the *gastro-intestinal* and the *cerebral*, but it is unusual, save in the last, to have influenza occurring without some degree of catarrh in the respiratory passages—the classification is made only to indicate what the outstanding features are in certain groups of cases.

The *simple febrile type*, has generally a sudden and severe onset. Without a moment's warning the patient may be seized, while at work or while walking in the street, with a severe rigor, accompanied by a feeling of general malaise and great enfeeblement, so that he can hardly drag one foot after the other. Almost immediately he may suffer from nausea, vomiting, giddiness and very severe headache either referred to the frontal region or behind the eyeballs, and he is seized

with acute pain in the back, particularly in the lumbar region, and aching in the limbs, referred rather to the muscles and bones than to the joints. He is conscious of a dry burning sensation in the nose, throat and eyes, and may suffer from the commencement from a "substernal rawness." The temperature rises at once, sometimes as high as 105° or 106° F., and a temperature of 104° F. is very commonly observed.

Pulse and respiration are greatly increased in rate, and the patient has a troublesome frequent cough not usually accompanied by expectoration. An herpetic eruption frequently appears about the lips, and blotchy erythemata have been occasionally observed on the skin of the trunk and limbs. After some three days of pyrexia, headache, malaise, prostration, anorexia, pain in the back and limbs, and dryness in throat, eyes and nose, the temperature subsides and the symptoms abate, some slight coryza and faucial secretion appearing as the temperature falls. Convalescence is uncomfortable and tedious, and it may be many months before a patient recovers his full mental and physical vigour, although his attack has been of the simple uncomplicated febrile type.

In *the catarrhal type*, after the usual symptoms of invasion, the patient is seized with acute catarrh of the eyes and nose, lachrymation may be extreme, and a profuse watery acrid discharge comes from the nostrils. The nasal discharge becomes purulent, and the conjunctivæ become deeply injected. The fauces and tonsils are usually acutely inflamed, and cough is troublesome, and may be attended with a feeling of "tearing" behind the sternum and slight mucous expectoration. Sleep is disturbed on account of the obstruction in the nose. Beyond a few snoring rhonchi heard in the upper part of the chest, no physical signs are apparent on examination of the lungs. The catarrh lasts for about a week and then clears up, sometimes with a little purulent expectoration ejected after slight coughing, and derived presumably from the fauces and trachea.

It is not uncommon, however, for such catarrhal cases to assume the *bronchitic type*, where the inflammation spreads from the fauces and trachea to the bronchi and lungs, and which constitutes one of the most dangerous types of the disease.

Shortly after the catarrhal symptoms appear the patient is seized with a sense of constriction in the chest, breathing is rapid and difficult, and cough is almost incessant and very distressing. Expectoration is scanty and viscid, sometimes purely mucous, sometimes tinged with blood, and sometimes mixed with small greenish mucopurulent masses, but always difficult of ejection. Auscultation of the chest reveals the presence of sibilant rhonchi and a few sticky râles. In a certain proportion of cases the temperature subsides in about a week. Before it reaches normal the expectoration becomes mucopurulent and fairly profuse and numerous rhonchi with mucous and sub-mucous râles are audible on auscultation of the chest. Even after the temperature has reached normal, the cough, expectoration and physical signs remain for several days at least and only disappear slowly as convalescence progresses. In other cases, however, the temperature remains high at the end of the first week, and the general condition of the patient and the physical signs make it plain that the catarrh has spread to the bronchioles and alveoli, and a lobular pneumonia is in progress. The temperature may be very high, even hyperpyretic, the patient tends to become cyanosed and may die, with gradually increasing dyspnœa and slow cardiac failure. In some epidemics, shortly after the occurrence of the initial catarrhal symptoms a lobar pneumonia develops in a considerable proportion of cases, which slowly involves one lung and, after the lapse of a week or ten days, at a time when crisis might reasonably be expected to occur, the other lung may become involved, and the consolidation spreads in it as in the lung first attacked. Such cases are extremely dangerous, and very often fatal. In those where crisis does occur the patients tend to collapse more frequently than in an ordinary lobar pneumonia, and if they rally from the crisis their convalescence is difficult and protracted. Delirium is very common in the bronchitic type, especially on the occurrence of pneumonia, whether lobar or lobular.

The *gastro-intestinal type* is that in which there is added to the symptoms of the ordinary febrile type the symptoms of an acute gastro-enteritis,—vomiting, diarrhœa and acute

abdominal pain. In some cases the gastro-intestinal symptoms are very urgent and the patient may die of asthenia or collapse.

Cases are occasionally met with in which the gastro-intestinal symptoms are the first which present themselves, and in these the diarrhœa is apt to be very profuse and watery, attacking the patient with great suddenness, and followed by profound collapse, almost choleraic in its intensity. Such cases very frequently prove fatal.

The *cerebral* or *nervous* type is not common in Great Britain, but in the course of some epidemics has been met with frequently on the continent of Europe. The onset of the cerebral symptoms occurs frequently without previous warning, but in some cases it is preceded by a few days' malaise with aching in the back and limbs and catarrh of the upper respiratory passages. The patient may become restless and violently delirious and may suffer from acute headache, and stiffness of the neck and of the muscles of the jaw may follow later. The delirium lessens in a few days and the patient may die comatose or slowly recover. In other cases severe headache or pain in the distribution of the fifth nerve or a sudden convulsion may be the first indication of illness, and these may be quickly followed by the occurrence of aphasia, a monoplegia, or hemiplegia, and stupor or coma may supervene. In certain cases the patient may suddenly become hemiplegic, aphasic and comatose without having been previously ill, as in a case of sudden cerebral hæmorrhage or embolism. It is a striking fact that in the cerebral type of influenza there may be practically no fever, and the pulse rate may not be raised. The great majority of attacks of the cerebral type prove fatal after a few days' illness, but occasionally recovery takes place.

Mild cases of influenza are very frequently met with, in fact they are the predominant type where no serious epidemic is raging. As a rule they are modifications of the simple febrile or catarrhal types, and have an insidious onset without rigor, so that one class of cases may present the characters of an ordinary nasal catarrh with perhaps more prostration during convalescence than is normal to a common cold, while

others suffer from headache, pain in the back and limbs, mental depression or giddiness with little or no fever. Even in such modified cases convalescence is slow, and patients suffer from mental depression, loss of the power of concentration and from muscular weakness out of all proportion to the severity of their illness. It is usual to describe the primarily bronchitic as the most dangerous of all the types of influenza, but many practitioners will agree that the most dangerous of all is that which begins as a mild form of the disease with little fever and few symptoms of catarrh, so that the patient does not immediately lie up, but struggles on for days until he falls a victim to one or other of the graver manifestations of the disease. An attack of influenza with an acute and severe onset protects by its very severity, and even if it develops as the bronchitic type of the disease, the patient, having been under observation from the onset, is more likely to survive a severe bronchitis or a pneumonia than one who has been weakened by over-exertion and exposure while suffering from a mild type of the disease with insidious onset, before the development of pulmonary trouble.

Diagnosis.—A typical attack of the simple febrile or the catarrhal type is usually easy of diagnosis, the only disease likely to be confused with a simple febrile attack being acute rheumatism, and there the definite location of pain in the joints and the less sudden onset will help to make the distinction plain. In the pulmonary type, if there is much consolidation of lung, the clinical differentiation of an influenzal from an ordinary acute pneumonia is very difficult, and, in those cases where the influenzal pneumonia is frankly lobar, impossible, without bacteriological examination Similarly, accurate diagnosis in the mild catarrhal types is also impossible without the recovery of the bacillus. In the cerebral type, lumbar puncture should be performed when the symptoms simulate those of a meningitis, to exclude the possibility of the case being one of epidemic cerebro-spinal or tuberculous meningitis.

Certain cases of influenza are mild and prolonged, with a tendency to relapse, and the use of Widal's test will help to differentiate such cases from enteric fever, and the use of

Calmette's ophthalmic reaction or of Von Pirquet's cutaneous reaction will help to exclude certain forms of tuberculosis which they may closely resemble. It is generally supposed that the bacillus influenzæ of Pfeiffer is the causal agent in epidemic influenza, and this organism may be recovered from the upper air-passages and the sputum. The bacillus is small and slender, with a tendency to stain at the poles and not at the centre, Gram-negative and growing only on media which contain hæmoglobin. It is very rarely found in the blood-stream, and does not give rise to true purulent meningitis. Cohen has described in the *Annales de l' Institut Pasteur* (1909, xxiii, 273), a bacillus which he recovered from the blood stream and from the subarachnoid space in certain cases of purulent meningitis, and which resembles the B. influenzæ of Pfeiffer both morphologically and in cultural characteristics, but has a different pathogenicity towards animals. This organism may bear the same relation to the B. influenzæ as does the B. paratyphosus to the B. typhosus.

Without the recovery of the B. influenzæ it may be quite impossible to differentiate a mild catarrhal type of the disease from the infectious coryza due to the micrococcus catarrhalis, in which a certain amount of shivering and pain in the limbs is very frequently met with.

Complications. — *Cardiac degeneration* with *dilatation* and *failure* are two of the most serious complications of influenza, and while they occur more frequently in cases of a severe bronchitic or pneumonic type they do occur in cases where the other symptoms have been deceptively mild. The symptoms are breathlessness, even on slight exertion, a rapid and irregular pulse, and some degree of cyanosis. The heart may be markedly enlarged to either side on percussion, and systolic murmurs may be audible at both the mitral and tricuspid areas. The symptoms of dilatation and failure of the heart not infrequently follow some exertion on the part of the patient or after he has been permitted to sit up or walk too soon. Death may occur with great suddenness, while in some cases the symptoms may persist for many weeks or even months before death supervenes, and in others a slow and tedious recovery is made. *Pericarditis* and *endocarditis* are

occasionally met with, and a few cases of acute infective endocarditis as part of an influenzal septicæmia have been recorded.

Various suppurative affections are met with as complications in influenza, the more common of which are acute purulent otitis media, abscess in the antrum of Highmore and empyema of the frontal sinuses. From these conditions, as from the acute suppurative *parotitis* which occasionally occurs, the B. influenzæ has been recovered. *Pleurisy*, both dry and with effusion, and *empyema* are occasionally met with, and *laryngitis*, both acute and subacute, sometimes occurs. In rare instances hæmorrhages occur from the nose, lungs or intestine, and an *optic neuritis* which does not usually proceed to atrophy has been described as an unusual complication.

Sequelæ.—During convalescence the patient is peculiarly *susceptible to chill*, and *bronchitis* and *pneumonia* of a very dangerous kind may follow on any undue exposure during convalescence. It is said that phthisis is apt to follow on an attack of influenza, and also that an attack of influenza will cause an exacerbation of his disease in a phthisical patient, but it would be well if these statements were founded on careful bacteriological examination, as it is a matter of common observation that the onset of phthisis pulmonalis may in certain cases very closely resemble the onset of influenza, and curious attacks of fever with prostration are met with in the course of phthisis, although in neither class of case has the B. influenzæ been isolated from the sputum or nasal secretion.

The most troublesome and constant sequelæ are those affecting the *muscular and nervous systems*, where lassitude, muscular weakness, a rapid pulse, mental depression and loss of the power of concentration may persist for many months after the attack has passed off. A tendency to vertigo may also persist for a long time. Peripheral neuritis has been observed, but rarely. It is no uncommon thing for a man whose work is mental and taxing to find that he is unable to study for many months after his attack of influenza, and he is conscious during that time that his "head is easily tired" and that he is incapable of prolonged concentration, while his memory,

although previously good, has become very treacherous. This loss of mental power tends to increase the depression which is so usual during convalescence, and a true melancholia may supervene, in the course of which a suicidal tendency may develop. In an epidemic of influenza in Scotland in 1890, an athletic highly educated young man who was one of the school inspectors appointed under the Scottish Education Department contracted the disease, and, although his attack was only a moderately severe one of the simple febrile type, his mental depression was such that during convalescence he went to the railway and laid his head down before an advancing express train. The form of mental derangement which follows influenza is usually melancholia, but various forms of mania have also been described. All kinds of neurasthenic and psychasthenic manifestations are apt to occur. The sense of taste and smell may be impaired for long after convalescence is established.

Treatment.—An essential in the treatment of influenza is that the patient should be kept in bed from the beginning of his attack until the evening temperature has been normal for at least three days, and until all catarrhal symptoms have disappeared. Thereafter he should remain indoors for some days, and should, if possible, take a holiday of some weeks' duration before resuming work, more especially if his work involves worry or mental strain. In this way many fatalities, and much of the distress caused by prolonged physical and mental weakness during convalescence would be avoided.

During the acute stage headache and fever may be relieved by sponging with cold or tepid water or by the application of cold compresses, as in enteric fever. A mustard plaster very often relieves the pain in the back. A combination of sodium salicylate (grs. iii), and the Liquor of the Acetate of Ammonia (℥xx) repeated every two hours is efficacious in promoting a reasonable moisture of the skin, and in relieving pain in the limbs; it tends, moreover, to lessen the intense feeling of congestion in the nose and frontal sinuses, which is often so distressing. Quinine in the form of the ammoniated tincture is also of service in cases where there is much fever, and should be given in doses of ℥i repeated

every three or four hours. When there is any bronchitis or laryngeal inflammation, Ammonium carbonate (grs. iii.) may be given in combination with spirit of Chloroform (℥ xv.), and Camphor water (℥i), the mixture to be repeated every two hours, and hot inhalations containing oil of Eucalyptus or Thymol will often relieve. I have found that a dry inhalation composed of Tr. Iodi Aetherialis, Ol. Creosoti, Ol. Eucalypti, et Spt. Chloroformi, in equal parts, is very servicable when there is any bronchial, tracheal, or laryngeal catarrh, giving ten drops on the sponge of a Squire's oro-nasal inhaler to be used for fifteen minutes frequently during the twenty-four hours. The application of heat to the front of the chest will often relieve the painful feeling of constriction even in adults. In bronchitic and pneumonic cases the state of the pulse and restlessness of the patient may demand the use of whisky or brandy, and this is best given in two or three doses in the twenty-four hours of ℥i each rather than distributing the same amount over the day in small doses every three or four hours. When there is much restlessness and delirium, without any pulmonary or bronchial catarrh, the hypodermic injection of $\frac{1}{6}$th gr. of morphine may be used with advantage, and repeated every three hours until quiet is produced.

In cases where coma had supervened, Sir William Broadbent recommended intramuscular injection of several grains of the hydrobromate of quinine, repeated if necessary three or four times in the day.

In cases which have shown acute cardiac failure it is best to use the hypodermic injection of strychnine, gr. $\frac{1}{30}$, with some twenty minims of ether, and to push digitalis after the patient has once rallied. In all cases where the pulse continues to be rapid, say over 110 for several days, digitalis should be used freely, combined, when there is much general irritability, with Ammonium bromide in doses of 10-20 grains.

Suppurative complications must be dealt with surgically as they arise.

The muscular and mental weakness which is so troublesome during convalescence should be treated by rest, change of scene and cheerful surroundings, while the bi-hydrochloride

of Quinine in doses of half a grain, with 5 minims of dilute nitro-hydrochloric acid, 3-5 minims of the Liquor of Strychnine and some Compound Infusion of Gentian may be given with advantage thrice daily before food. It is of the utmost importance that any patient who shows the slightest tendency to melancholia should be very carefully watched on account of the liability which such people show to develop suicidal tendencies.

Diet.—The diet during the acute stage of influenza should be bland and fluid, iced if the patient so desires it, and should consist rather of very thin gruels, milk diluted with soda-water or barley-water, and barley-water itself rather than soup, to which many patients profess a strong objection.

As convalescence is established, a generous diet should be given as soon as the patient's appetite permits, and the greatest care should be taken that its nutritive value is high. To those who are accustomed to the use of alcohol in health it should be given during convalescence, as the sense of well-being which it induces is of value, but it should not be urged on those who are not accustomed to take it, as the very sense of well-being which it produces may cause the establishment of a habit of alcoholism in those who were previously abstainers.

Epidemiology.—Influenza swept across Europe from Russia in 1889, and since 1890 Great Britain has been liable each winter to epidemics of greatly varying severity. In some years the disease has shown itself mainly as an unusually severe kind of nasopharyngeal catarrh which has tended in certain cases to spread to the bronchi, and after which convalescence was tedious, while in others the grave types have predominated, and patients have died in considerable numbers from influenza of the pulmonary and intestinal types. One attack confers little or no immunity. It is a common thing to find that patients have had two attacks of moderately severe influenza in the same winter, but many who seem to fall a victim to the disease almost every year say that the first attack they had was severe and typical, while the subsequent two or three attacks have been atypical and mild, but that after a few mild attacks, they have again suffered from a severe and

typical influenza which is again followed by two or three mild attacks, and so the rotation goes on. It is, however, difficult to be certain about the accuracy of their statements, as any infectious coryza associated with aching in the limbs and back is too readily diagnosed as influenza at the present day.

Method of Infection.—Influenza can be spread by direct contact with infected persons, and also by means of various fomites, such as clothing, furniture, letters, parcels, &c. Most severe epidemics are preceded by the occurrence of a few sporadic cases, which presumably spread the disease among those with whom they come in contact. The tendency for influenza to spread through institutions and households is in itself proof of its great infectivity.

Period of Infectivity.—While it is true that the disease is most infectious in its early stages, patients are capable of conveying the infection to others directly for at least some days after the acute symptoms have subsided, and it is probable that infected fabrics are capable of retaining the infection for a long time after they have been in contact with a patient suffering from influenza. It seems likely, judging from the frequent small outbreaks of the disease in country districts which occur shortly after the arrival of supposed convalescents on holiday, that we are too careless in our isolation of cases of influenza and in the disinfection of clothing and other articles which have been exposed to the infection.

Death-Rate.—The percentage mortality among cases attacked is small, but in any widespread epidemic so many of the community are attacked by the disease that the fatal cases cause a marked increase in the local death-rate during the period of the epidemic. Influenza is much more fatal in elderly people than among young adults, while children usually exhibit a mild type of the disease. Pre-existing cardiac disease, a tendency to bronchitis, any organic disease of the kidneys or liver, or a bad history with regard to alcoholic excess are all factors which militate against the recovery of a patient. The mortality is high among those who show severe cerebral or gastro-intestinal symptoms, who have much bronchial catarrh, who develop pneumonia, either lobar or lobular, or show any marked tendency to cardiac failure.

Home Prophylaxis.—A patient suffering from influenza ought to be isolated as far as possible from the other members of the household; his room should be vacated at the end of the attack and its contents disinfected before it is re-occupied. All bed clothes and washable materials in the room should be steeped in a 1-20 solution of carbolic acid and afterwards washed. The carpets, hangings, furniture, and outer clothing ought to be sprayed with formalin solution and thoroughly aired before being used again, while the walls should be exposed for twenty-four hours to the vapour of formalin, and the room freely ventilated for at least a day. It would seem probable that the organism of influenza is capable of living for long periods in furniture, in the corners of rooms, and in clothing which has been exposed to infection. I know of one family, the members of which were for years the victims of attacks of influenza of a very typical kind occurring in early winter or spring until they thoroughly disinfected their house and furniture, besides the usual repapering and painting of the rooms, during one summer when they were on holiday. In the past two years no member of that household has suffered from influenza.

Public Health Administration.—Although influenza is not a notifiable disease, it is well that the local authority should afford facilities for the disinfection of houses and clothing to those who may desire it, and who are unfavourably situated for the carrying out of efficient disinfection for themselves.

Chapter XII.

PULMONARY TUBERCULOSIS.

Synonyms :—Consumption; Phthisis Pulmonalis.

French: La Phthisie.

German: Schwindsucht.

Definition.—An inflammatory process in the lungs characterised by catarrh, consolidation, caseation and fibroid changes, caused by the *B. tuberculosis*, discovered by Koch in 1882.

Incubation Period.—The incubation period of phthisis pulmonalis is quite indefinite. The only case which I have known in which it seemed likely that the time of infection could be fixed with any accuracy was where a young woman was undergoing a course of "Weir-Mitchell" treatment in a nursing home. She was in the home for some eight weeks, and three months after she left, she developed symptoms which made her physician suspect the existence of phthisis pulmonalis, and the sputum was found to contain large numbers of the B. tuberculosis. Enquiry was made at the nursing home with a view of discovering a possible source of infection, and it was found that the patient who had been the last occupant of the room in which the young woman received her "Weir-Mitchell" treatment, had died of an advanced tuberculosis of the lungs, and the room had not been disinfected before the admission of another patient.

It is probable that the incubation period may be anything between a week or two and some years, during which the bacillus lies latent and produces no apparent disturbance of the patient's health. But anything like accurate determination is usually impossible, as it is only after repeated exposure

to infection, and even then most commonly as the result of an hereditary predisposition or a loss of resistance on the part of the patient due to the influence of some other disease, that pulmonary tuberculosis is acquired.

Rash.—No rash has been observed as typical of the disease, but, as in all the acute infectious fevers, erythemata and morbilliform rashes have been observed as unusual occurrences in its course.

Clinical Types.—In discussing the clinical types of pulmonary tuberculosis I do not propose to describe at any length the physical signs to be met with in the lungs, as they fall more naturally to be described in a treatise on general medicine, and I shall merely indicate briefly the signs met with in the several types which are necessary for the diagnosis of the disease and its complications.

The clinical types usually described are *miliary tubercle of the lung, pneumonic phthisis, chronic phthisis with softening,* and *fibroid phthisis.*

Miliary tubercle of the lung is commonly a part of a general infection by the B. tuberculosis of the whole body and the lungs are affected along with the other viscera. Its onset, unless ushered in by the occurrence of meningeal symptoms, resembles that of enteric fever. Physical signs in the lungs are frequently absent, and if present they resemble those of an acute catarrhal affection involving the smaller bronchi—diffuse sibilant rhonchi, mucous, submucous and subcrepitant râles. When the pleura are involved some fine crepitus will be audible.

As a rule there is a widespread diminution in the volume of the respiratory murmur, and small areas of dull percussion may be detected, while it is not at all uncommon, especially in children, to find that the front of the chest yields a hyperresonant note on percussion, due possibly to an acute emphysema. The temperature is raised, and may be high, 102° and 103° F. being quite usual readings. The fever is usually of the *continued* type. The pulse is rapid and soft. Breathing is difficult and rapid, and there is in the great majority of cases very marked cyanosis of the lips, face and extremities,

even of the skin generally. With this type of pulmonary tuberculosis the spleen and liver may be enlarged, meningitis may develop, and tubercles may be visible in the choroid. There may be acute diarrhœa or constipation with considerable swelling of the abdomen. It may be said definitely that this form of the disease is always fatal, and may run its course in a week or two. Sometimes, however, it may be protracted for several weeks, or even months.

Pneumonic phthisis: In this type of the disease the lesion may have the character of a *lobar pneumonia* or of a *broncho-pneumonia*. The onset is usually sudden and severe, often with rigor, and the patient suffers much with cough and pulmonary distress. The physical signs may be those of lobar pneumonia, and nothing save the examination of the spit may give any indication of the infecting organism. In certain lobar cases the disease may be fatal within the first fortnight, but as a rule, its course is more prolonged than an ordinary acute lobar pneumonia, and death does not commonly occur until the patient has been ill for a couple of months. The temperature at the first behaves just like that of an acute lobar pneumonia, and physical examination shows that one lobe or more of a lung is in a stage of consolidation. Instead, however, of having a crisis about the seventh or eleventh day, as in an ordinary acute lobar pneumonia, the condition tends to be aggravated, the temperature becomes markedly remittent and the pulse rate increases, the sputum becomes muco-purulent and often has a greenish colour. Signs of softening are to be made out in the lung and the examination of the sputum will reveal the presence of tubercle bacilli and elastic tissue. In the majority of cases death occurs at anything between the third week and the third or fourth month, but in some cases the acute symptoms pass off and the disease assumes a chronic type.

In those cases where the lesion is *broncho-pneumonic*, the onset is also sudden and acute, resembling closely the onset of an ordinary broncho-pneumonia. At the end of a week or two, however, the symptoms show no abatement, the temperature takes on a markedly remittent character, and the patient may die after an illness of a few months, or the disease may drift

into the chronic form. There is nothing in the character of the physical signs to indicate that the broncho-pneumonia is tuberculous, as they differ in no way from those of a broncho-pneumonia of an ordinary type.

In both kinds of pneumonic phthisis the patient is commonly flushed at the onset, but becomes more or less cyanosed as the disease progresses. The lesions in the lung tend to be more frequently apical than in non-tuberculous pneumonia and broncho-pneumonia.

Chronic phthisis with softening. — This type may be chronic from the commencement of the disease, or may result from one or other of the pneumonic types. Where the onset has been acute and severe the chronic type develops from the pneumonic by a gradual modification of the symptoms. Fever becomes less marked, cough and wasting are not so urgent, the patient loses the flushed febrile look and begins to feel stronger and have more appetite. The physical signs in the chest tend to limit themselves to one or other upper lobe, collateral catarrh disappears, and the definite lesion compounded of catarrh, consolidation and softening becomes gradually more and more apparent. Excavation may proceed and a cavity form, or the disease may spread to other parts of the lung and the phenomena of moist crepitations, bronchial breathing or signs of cavity may be discovered in the lower parts of the lung, whereas the primary lesion was situated in the upper. Pleurisy may develop, with or without effusion. As the softening proceeds the sputum becomes muco-purulent and even frankly purulent, while as a cavity forms the typical "nummular" expectoration may be met with. The temperature is, as a rule, markedly remittent, with a morning fall and an evening exacerbation. The daily variation may be large, and it is not uncommon during the course of one of the more rapidly advancing cases of the chronic type to have frequent febrile movements of considerable severity. In a certain proportion of cases the disease goes on to spontaneous cure, even after treatment of the most inadequate description. The moist sounds in the lung disappear, constitutional symptoms abate, and cavities, even of considerable size, dry up and shrink, causing little embarrassment. In other cases, however,

the disease does not tend to cure, but steadily advances with variable rapidity. Febrile exacerbations are common, and the patient suffers from a profound toxæmia begotten both of the B. tuberculosis and the pyogenic infections which are so common in the softening lung. An acute pneumonia or bronchopneumonia may be superadded to the tuberculous condition, and even after years of chronicity the patient may die of an acute form of phthisis following, apparently, on the occurrence of some acute infection other than tubercle. Death may ensue from asthenia or one of the numerous complications which may occur.

The great majority of cases of phthisis are, however, chronic from the beginning. Their onset is insidious and slow, and it may be long before a patient feels ill enough to consult a physician and further delay may result from difficulties in early diagnosis. A slight "cold" which does not get well properly and which is accompanied with cough, an unexplained anæmia, dyspepsia, loss of weight, and an increasing sense of lassitude and "unfitness," may be the first indications that anything is wrong, and even when the patient comes under observation it may be long before any physical signs are discovered in the chest. Soon, however, a little dullness at one or other apex or over the apex of the lower lobe of a lung becomes apparent, and auscultation reveals a degree of bronchial breathing which varies with the situation of the lesion, being sometimes loud and marked and sometimes distant and difficult of detection. At the same time it is usual to be able to detect at least a few râles with inspiration, although these may be masked by the development of a bronchitis which is confined to the apical region of one or other lung. In some cases a fairly widespread bronchial catarrh may be the first lesion detected in the chest, and may give rise to no suspicion until it is found that, while it clears up in other parts of the lungs, it lingers at an apex. Sometimes the occurrence of hæmoptysis is the first sign of illness, and after this occurrence the signs of a lesion at one apex usually develop fairly quickly. The progress of a case after an early apical lesion is detected varies much in individuals according to their natural resistance and their social and climatic

environment. In cases where the patient has command of money or influence or has no people directly dependent on him, he may be placed under circumstances which will lead at least to an arrest of the tuberculous process, and be able to afford himself the leisure and the freedom from money-earning which is a necessary part of the treatment. In a certain number of cases a naturally great resistance will enable him to keep the disease in check even under unfavourable circumstances, but in the great majority of patients who are the subject of phthisis, unless able to undergo treatment under very favourable climatic and hygienic conditions, the disease develops and spreads until death follows on years of uselessness and invalidism during which the patient has the misery of seeing his occupation slip from him and his immediate dependents living either on the resources of the parish or the goodwill of friends. Catarrh, consolidation, softening and excavation extend, and the patient dies from asthenia or from some complication as already described. The refractoriness of certain cases which show few and insignificant physical signs in the chest leads one to suspect that a widespread but deeply-seated lesion may express itself most inadequately by appreciable physical signs. In estimating the severity and progress of a case of chronic phthisis the general condition of a patient is of far greater value than the physical signs in the chest; it is not the local but the constitutional effects of the toxins which are to be dreaded. Everybody is familiar with the man who lives on with half his lung tissue gone, and also with the unfortunate who dies with a local lesion curiously disproportionate to the severity of his general symptoms. The consideration of these natural variations of the disease are of the utmost importance when the question of treatment comes to be considered.

Fibroid phthisis.—In this type of the disease the main lesion is a fibrosis of the lung which may follow on a tuberculous pleurisy with thickening of the pleura, or on a chronic tuberculous broncho-pneumonia. In many cases it follows on the arrest and limitation of a chronic tuberculosis of the lung where a cavity has formed which becomes surrounded with a dense layer of fibrous tissue, when the pleura become thickened

and the fibrosis spreads throughout the lung. Fibroid phthisis is extremely chronic in its course.

The physical signs are those of shrinking of the affected lung with some compensatory emphysema on the opposite side. Signs of cavity may be apparent, indicating either the presence of an old cavity, the result of previous softening, or the dilatation of a bronchus secondary to the shrinking of the lung. When the cavity is bronchiectatic expectoration is apt to be profuse and fœtid. Cough is troublesome and may be paroxysmal in character. Oedema of the legs and feet may result from failure of the right heart, and amyloid degeneration of the kidney, spleen or liver may occur from the long-continued suppuration in a cavity or in dilated bronchi.

Complications.— All the viscera may become infected by the bacillus of tubercle during the course of pulmonary phthisis. Tuberculous ulceration of the larynx, and of the mouth, tongue and gastro-intestinal tract generally may take place. A tuberculous meningitis may occur, and tuberculosis of the liver, spleen and kidneys are met with as the result of a generalised tuberculous infection secondary to a lesion in the lung and bronchial glands. Tuberculous pyosalpinx is not uncommon among women in advanced stages of pulmonary phthisis, and tuberculosis of the bladder and testicle may also occur. Degeneration of the cardiac muscle and thickening of the pulmonary artery are frequently met with, and in the later stages of the disease a rapid feeble pulse with dyspnœa which is exaggerated on exertion is very common. In such cases apical and basal systolic murmurs are audible, usually without any valvular lesion being present. Loss of appetite and pain or discomfort after food are often extremely troublesome and hinder treatment. Diarrhœa is frequently a serious complication even early in the disease but is more common in the later stage, due to ulceration of the ileum with concomitant catarrh, or, in some instances, to amyloid degeneration of the mucous membrane.

Hæmoptysis may occur late or early in the disease. When early, it is not in itself dangerous, although it may be severe and prolonged, but when it appears as a late occurrence, in connection with cavity-formation or a fibroid condition of the

lung it may be extremely dangerous and is not infrequently fatal.

Diagnosis.—The diagnosis of pulmonary consumption depends very largely in most cases on the discovery of physical signs, and, as the patient usually presents himself in the early stages of the disease, these may be slight and limited. A little deficiency in expansion in one or other apex, with diminution in the volume of the respiratory murmur and a little impairment of the percussion note may be all that there is to indicate the lesion, and in no department of clinical medicine do *finesse* and accuracy tell so much as in the detection of an early lesion in phthisis. The slightest variations from the normal in expansion of the chest and in the results of auscultation and percussion should be carefully noted, and the sputum should be examined in every suspicious case. In certain cases the detection of bronchial breathing, with or without moist crepitations or occasional clicking râles, together with slight but definite dullness on percussion make the diagnosis easy when combined with the history of the case and study of the temperature. In other cases, however, although they have suffered from cough and certain constitutional disturbances, the most careful examination by a competent physician may fail to reveal the presence of any physical signs, and the diagnosis may be arrived at only after careful study of the history and temperature and examination of the sputum. In many cases the occurrence of a pleurisy, with or without effusion, is the first incident in the patient's illness, and the detection of a pleurisy in a young person should always arouse in the mind of the physician the suspicion that it may be of tuberculous origin. Hæmoptysis, severe or slight, may be the first circumstance which draws the patient's attention to the state of his health, and is, in the absence of any obvious lesion in the heart, nasopharynx or pharynx, very suggestive of early phthisis. A catarrhal condition of the lung which becomes limited and unilateral and does not clear up in a few weeks should make the physician careful to exclude the possibility of its being the result of an infection by the B. tuberculosis. Most patients give a history of general deterioration in health, a cough which, although

perhaps not severe, will not yield to ordinary treatment, some loss of appetite and dyspepsia with more or less pallor and, the most common part of the story, distinct loss of weight, sometimes very marked. There is frequently a history of sweating at night, and some pain in the upper part of the chest. All young subjects who suffer from chronic dyspepsia, persistent slight anæmia, and rapid and unexplained loss of weight, should be most carefully examined for signs of tuberculosis, and no examination is complete without the careful and repeated examination of the sputum for the bacillus of tubercle and a systematic observation of the temperature, especially after exercise in the afternoon. Many patients with no physical signs suggestive of phthisis but who suffer from one or more of the symptoms just described will be found to have a distinct, if slight, rise in temperature each afternoon or evening, and may have the bacilli of tubercle in their sputum in considerable numbers. One negative examination of sputum is not sufficient to exclude the possibility of phthisis, indeed even repeated negative examinations are not enough for the physician of experience. It is far better to treat on suspicion than to wait for absolutely definite evidence, especially as many cases who have been ailing for long with indefinite symptoms, having no definite signs in the chest and no bacilli in the sputum, may suddenly present all the signs of a rapidly advancing phthisis, and in such cases the end often comes with startling rapidity. In children, the sputum is difficult to obtain, and when they cannot be made to expectorate, coughing should be induced by putting the finger deeply into the mouth, and the mucus adhering to it should be examined for bacilli on withdrawal. It is of the utmost importance, for purposes both of diagnosis and prognosis, that the history of a case suspected of phthisis pulmonalis should be carefully ascertained. A predisposition to phthisis is undoubtedly hereditary, and while all hereditary predispositions can be modified, and many can be eradicated, by environment, it is a matter of common experience that a bad family history is a serious handicap to a patient with consumption, and a valuable aid to the diagnosis of latent pulmonary tuberculosis.

In examining the chest of a patient suspected of phthisis, the physician ought to remember that next to the upper lobe the apex of the lower lobe is the most usual place for the physical signs of the disease to make their first appearance.

The X-rays are a powerful aid in the diagnosis of pulmonary tuberculosis.

The production of a general reaction by the use of tuberculin has been recommended for diagnostic purposes in doubtful cases, and while many believe that the practice is scarcely justifiable, I have never seen bad results follow on the use of the old tuberculin if it is given in doses of $\frac{1}{1000}$ c.c. as an initial dose. Calmette's reaction is advocated by some, but as in some cases a serious inflammation of the eye has been the result of the procedure, it is not to be strongly recommended. Von Pirquet's skin reaction is frequently of service.

Treatment.—The medical treatment of no disease has undergone so much modification in the past twenty years as that of phthisis. The realisation that many cases of pulmonary consumption proceed to spontaneous cure has led to the general adoption of the "open air" and "climatic" forms of treatment, which have for their object the improvement of the patient's general condition by "fresh air and good food," thus increasing his resistance to the disease, and which have raised so many hopes in the minds of consumptives. What the outlook of a patient suffering from pulmonary tuberculosis was in early Victorian days can be realised from the description given in "Nicholas Nickleby." "There is a dread "disease," writes Charles Dickens, "that so prepares its "victim, as it were, for death; which so refines it of its "grosser aspect, and throws around familiar looks unearthly "indications of the coming change; a dread disease, in "which the struggle between soul and body is so gradual, "quiet, and solemn, and the result so sure, that day by day, "and grain by grain, the mortal part wastes and withers "away, so that the spirit grows light and sanguine with its "lightening load, and, feeling immortality at hand, deems it "but a new term of mortal life; a disease in which death and

"life are so strangely blended, that death takes on the glow "and hue of life, and life the gaunt and grisly form of death; "a disease which medicine never cured, wealth never warded "off, or poverty could boast exemption from; which some- "times moves in giant strides, and sometimes at a tardy "sluggish pace, but, slow or quick, is ever sure and certain." These are the words of a layman and a man prone somewhat to dramatic exaggeration, but the substance of the passage is true in the main, and the attitude towards phthisis up till the last quarter of the nineteenth century was one of hopelessness, and every quack with a new nostrum was always sure of a *clientèle*. Since then, however, the treatment by fresh air and reasonable feeding has changed the attitude of the patient and the physician alike, and the results obtained in sanatoria, both at home and abroad, seem to warrant a hopeful attitude towards the disease. The early days of sanatorium treatment were rendered ridiculous by the inclusion among the therapeutic measures of an over-feeding so gross that those of strong stomach who could tolerate an overloading which was nothing short of disgusting grew fat and unwieldy, and, while they put on that weight which was supposed to be the great indication of betterment, showed in every other way that they had acquired little added powers of resistance and broke down in large numbers when sent back to face life once more at home. No more ridiculous statement has ever been made in medical literature than that if a patient grows fat the disease may be considered as a negligible quantity. It is greatly to the credit of Huggard of Davos that he stood out against over-feeding and looked upon an increase of weight above the patient's normal as no favourable sign. At the present day over-feeding has largely slipped out of the treatment of phthisis and much more stress is laid on other things. Graduated exercise as introduced by physicians in continental sanatoria and health resorts has been developed lately by Paterson of Frimley to a great degree of perfection and his results are most encouraging, indeed surprising. Excessive feeding has no place in his programme, and his patients receive just as much food as is necessary for the work which they are doing. The general principles which underlie the modern treatment of

pulmonary tuberculosis are these—the putting of a patient under as good hygienic conditions as possible as regards fresh air, food and cleanliness, and helping him to acquire an immunity against the B. tuberculosis, so that his tissues may be able to bring about that cure of the disease with cicatrisation of the infected foci which, as the study of lungs *post mortem* has shown us, takes place so frequently even under most unfavourable circumstances. Paterson's work has made it clear that, although the local lesions may not entirely disappear, it is possible to raise the immunity of the patient so much by exercise of a suitable kind that he may be able to do work without discomfort and without constitutional disturbance in spite of the existence of the local lesion, indicating that although the bacilli may be present in the lung, they have sunk to the level of mere saprophytes, so far as the production of symptoms is concerned. To have the patient in as clean an atmosphere as possible is one of the important parts of the treatment, and much wind, damp, and dull depressing weather are adverse climatic influences. It was because the high Alpine climates fulfilled these conditions, because their atmosphere was still and exhilarating and their hours of sunshine more numerous than in any part of Great Britain, and because they were far removed from the contamination of manufacturing towns, that their reputation as health-resorts for consumptives stood so high. But their altitude is to many a great disadvantage, while the cold snow-atmosphere is unfavourable to those who suffer from bronchitis or laryngeal tubercle, and within the last ten years sanatoria have sprung up in many parts of the British Islands which have given results, perhaps not so good as those to be obtained in better climates, but sufficiently good to show that the modern treatment is far in advance of the old. In the great majority of cases the life of the patient is prolonged and rendered more comfortable, while his training in the knowledge of the infectivity of the disease and in the best methods of prophylaxis, has greatly reduced the danger of his presence in the community. But the disadvantages of the ordinary sanatorium treatment soon became apparent. While a certain drag was put on the disease, while physical signs disappeared and patients

were able to return to their native places in better state than when they left, the habits of invalidism were strong in them, and they had for the most part acquired a timidity in resuming work, a timidity which was greatly justified by the breakdown of so many who tried to take up work again as usual. Something was wanting. Although the disease was arrested, the slightest overstepping of rules resulted in most cases in at least a partial recurrence of symptoms, and it became evident that the patient dismissed from the sanatorium as "cured" was still among the ranks of the unfit. After a struggle for a time against ill-health the break-down came again, and the patient had to retire from active life and live once more for his health. When he was a man of means, who could provide for his family and still live abroad or in favourable climates at home, his case was not so hard, but when he had no private means and depended entirely on his daily work for a living and for the means to support his family, his condition was not only a tragedy to himself and his immediate dependents, but a burden to the community in which he lived. Parish relief was necessary in some form or other both for himself and his family, and his use as a wage-earner was gone. It was evident that the immunity acquired by rest, fresh air, and gentle, more or less regulated, exercise was not enough, in the majority of cases, to allow a man to do full work and preserve his health. The work of Wright brought new light to bear on the subject of acquired immunity and has made it possible to use inoculation and auto-inoculation as most useful aids to the "open-air" treatment of pulmonary phthisis. Tuberculin rightly used, and exercise properly supervised and regulated. have brought new hope to those who had been bitterly disappointed by the results of treatment merely by "fresh air and good food."

All patients suffering from phthisis should be put to bed at once, and careful observations made of their temperature. It is usual to find, even in early cases of the more chronic type, that the temperature is somewhat raised, the fever being of a remittent or an intermittent type with a morning reading of nearly normal or normal, and a rise in the afternoon to a

register that is subfebrile or febrile. The temperature should always be taken at 4, 6 and 8 p.m., so as to be certain that the evening rise is not being missed. If there is fever, the patient must be treated, as in enteric fever, by *absolute rest* and not permitted to do anything for himself. Absolute rest ought to be maintained until the evening temperature has been normal for a few days, and the patient begins to feel better and stronger. At the end of that time he may be allowed to get up, at first only in the afternoons, and in a few days, if no febrile disturbance follows this move, he should go for a slow walk of, say, half-a-mile on the level. If he is fairly vigorous and has no fever within an hour after his walk, the walk should be extended after three or four days to a mile, and again to a mile and a half and again after some days to two miles, while into the extended walk should be introduced a mild incline to make the patient do actual work against gravity. The pace should be steady, slow and deliberate, and no hurrying should be allowed. If a severe reaction occurs, as shown by a feeling of malaise and chill, with fever which does not disappear within an hour after exercise has ceased, absolute rest must again be enforced and only after all fever has disappeared should the patient be allowed to walk again. If no severe reaction occurs the next move is to make the patient walk carrying a small quantity of earth in a basket from one place to another and then empty it, going back with the empty basket for more earth, always taking care to be deliberate and slow in all movements. The amount of weight carried should be carefully increased until the patient can carry and empty out baskets filled with several pounds of earth for six or seven hours in the day. His next work ought to be trimming wood with an axe, followed by using a lawn mower. Cross-cut sawing may then be attempted, after which he should begin to shovel light earth, the size of the shovel being carefully graduated to his capacity, and the final kind of work should be the use of the pick, taking care that, at least at the commencement of the work, his movements should be regular and not over-active. Such is a rough outline of Paterson's method of treatment as carried out by him at Frimley, and his results would seem to fully justify his faith in it. If the

patient has a severe reaction at any stage of the treatment, he is at once put back to absolute rest. After all fever has disappeared, he is brought back, after a couple of days out of bed without exercise, to a day or two's mild walking, and is then put straight on to the work at which he broke down. It will be seen at once that the principle involved in this method of treatment is one of auto-inoculation, and the object is to produce by work a reaction that is within the patient's powers of endurance. If a severe reaction occurs it shows that the auto-inoculation has been too great, and a period of rest must follow. When, however, the reaction has subsided, it is not necessary to work up slowly again to the point at which the severe reaction has occurred, but work may be resumed at the point up to which tolerance has been educated. One of the great advantages of this method of treatment is that the patient is receiving inoculation by the toxins of his own bacilli, which is known to be an important point in successful vaccine-therapy, but the results which Paterson obtains at Frimley may possibly be obtained for the many who are unable to be treated there by a system of graduated exercise, even when there is no opportunity for the use of the axe, saw, shovel and pick, combined with the use of tuberculin. The great disadvantage of the human tuberculin at present available seems to me to be that it is a vaccine obtained after the passage of the B. tuberculosis through an animal and not made from bacilli cultivated directly from human beings. Twort has shown that the bacillus of tubercle can be easily cultivated directly from the sputum on suitable media, and if a vaccine were able to be made from the particular organism infecting each patient directly from their sputum, it is probable that vaccine-therapy in pulmonary tuberculosis might give much better results than at present. We do not know what alteration takes place in the virulence of the B. tuberculosis during its passage through an animal, but that some alteration does take place is extremely likely. Even at the present, however, the careful use of tuberculin has given good results in the hands of many physicians. It is usually injected hypodermically, but Latham has obtained encouraging results after its administration by the mouth.

Methods of using Tuberculin.—Several kinds of tuberculin are in the market, O.T. (the original tuberculin of Koch) P.T.O. (a dilute bovine tuberculin), P.T. (a stronger bovine tuberculin), T.R. (the new tuberculin of Koch), and B.E. (a bacillary emulsion). Of these, T.R. and B.E. are the most commonly used, the latter being said to be particularly effective in chronic febrile cases.

Camac Wilkinson begins treatment by the injection of P.T.O., working up to P.T., and finally using T.R., in carefully graduated doses. He recommends employing an initial dose of ·001 c.c. of P.T.O., increasing on the next occasion to ·0015 c.c., and thereafter increasing the dose by doubling the penultimate dose. The patient should be seen at least twice a week, preferably three times. In Dr. Mackenzie's out-patient department at Mount Vernon Hospital and at the Margaret Street Hospital for Consumption we (McClure and Barcroft) have been employing the methods of Wilkinson for some two years past, and have seen the patients twice in the week. In this method the dose is governed entirely by the reaction to the injection which patients present, and no patients who show a temperature of over 99·6° at any part of the day are considered suitable for treatment. The patient's temperature is studied carefully for a week, being taken thrice daily, at 8 a.m., 4 p.m., and 8 p.m., and if, during that week, no febrile movement has occurred beyond the above-mentioned limits, treatment is begun, or, if there be a doubt as to diagnosis, a test injection of ·001 c.c. of O.T. is given. If after an injection there has been a definite reaction-temperature, or very severe local reaction, a dose is omitted and on the next visit the previous dose is repeated. If on this occasion there is no reaction-temperature, or only a very modest one, the method of doubling the penultimate dose is resumed, and continued until another severe reaction necessitates a similar pause. If a patient shows great susceptibility to the tuberculin, it is well to give half the dose at which the patient has broken down three times a week, then give the dose to which the patient has shown himself susceptible, and, should no reaction occur, proceed with the series as before. In

this way a patient who has repeatedly jibbed at the same fence may be tempted past it quite safely. Dosage is then increased until ·8 c.c. of P.T.O. has been given, after which treatment is begun with P.T., ·01 c.c. being the first dose. As before, the next dose is ·015 c.c. of P.T., and the treatment is continued until ·8 c.c. of P.T. has been given as a dose, the same care being paid to the reaction as before. Then ·01 c.c. of O.T. is given, and the process continued, until an injection of 1 c.c. of O.T. completes the series.

The whole success of this method of treatment depends on the steady and regular increase of dosage, and the close observation of the patient two or three times a week. If dosage is irregular or not increased as above indicated, it seems likely that a condition of hypersensitiveness may be produced and the patient may suffer harm.

T.R. is commonly used, also in afebrile cases, by the injection of $\frac{1}{20000}$ of a milligram to begin with, and the dose is increased gradually, twice a week, by doubling, in the smaller doses, and increasing by half as the dose gets moderately large. The dosage should be worked up to 5 milligrams, the same precautions regarding reaction being taken as above described.

Treatment by B.E. is done in a precisely similar way, save that the initial dose is even smaller, as a rule $\frac{1}{500000}$ of a milligram being commonly used. B.E. is of great service in the treatment of obstinately febrile cases and cases which react too readily to the other varieties of tuberculin, while it is frequently employed to complete the treatment of a case which has had other forms of tuberculin in doses too large to warrant continued increase, but when the symptoms seem to demand further treatment.

The treatment of out-patients by means of tuberculin is of great interest at the present moment when there is talk of a great increase in the number of national sanatoria for the treatment of consumption. It is very evident to most people who are actively engaged in work among consumptives that sanatorium treatment has been found wanting in many respects, more especially if it is conducted on old-fashioned and "accepted" lines, while the "dispensary" system is capable of much

useful development. It would seem that the establishing of dispensaries at which patients could be treated by tuberculin, in one way or another, and from which the home condition of the sufferers could be supervised, would be a much more effective and economical way of fighting consumption than the building at enormous expense of numerous sanatoria that might in a short time serve simply to act as monuments of the folly of the age. Sanatoria will always be necessary for the isolation of advanced cases and the training of the unintelligent, but to rely on sanatorium treatment as the great weapon for the fight against consumption is unwise, both from the point of view of medical knowledge and national finance.

It is not possible at present to make up one's mind definitely as regards the relative efficacy of the various methods of tuberculin treatment. It is enough to watch carefully and compare the results of those who are employing different methods and take care neither to praise nor to blame without sufficient cause. It must be remembered that treatment by tuberculin ought not to be attempted by any practitioner unless he has obtained practical experience of the difficulties which may arise in the course of treatment, by working with one who has extensive practical and theoretical knowledge of the subject. In dealing with vaccines we are dealing with remedies which may prove very dangerous in inexperienced or careless hands.

Continuous inhalation.—Some physicians prefer to treat the patient by the continuous inhalation of volatile drugs, and the result of this form of treatment by Lees in fifty cases appears in the Proceedings of the Royal Society of Medicine for 1909 (vol. 3, part iii.) and in the *Lancet* of November 19th, 1910. The inhalation which Lees employs is composed of carbolic acid ℥ii, creosote ℥ii, tincture of iodine ℥i, spirit of ether ℥i, and spirit of chloroform ℥ii. Six drops of this solution are used in the sponge of a Squire's oro-nasal inhaler, which must be worn continuously, day and night, and the patient should be directed to inspire through the mouth and expire through the nose, the drops on the sponge of the inhaler being renewed every hour during the day and twice or thrice during the night if the patient is awake. Lees states that

under this method of treatment his cases showed marked improvement, and 25 out of his first series of 30 cases he regards as "cured," 13 of them having worked for upwards of a year without a relapse. It is difficult to see what directly bactericidal effect such small quantities of antiseptics can have, but in my own experience I have found that the use of a somewhat similar inhalation (equal part of the æthereal tincture of iodine, creosote, eucalyptus oil and spirit of chloroform) has been of the greatest use in subduing cough and lessening catarrh, and patients have made great improvement under its influence. It is probable that in many cases, especially in those which have an acute onset, with a fair amount of catarrh and considerable cough, the use of such continuous inhalations will prove a valuable adjunct to the treatment by fresh air, exercise and tuberculin. I have found it necessary to omit the creosote in certain cases because it seemed to produce nausea, which disappeared on its withdrawal.

Treatment by the production of an artificial pneumothorax.—In certain advanced cases of phthisis, when there is much expectoration and where the lesion is mainly unilateral and where, also, there are no pleural adhesions of any great extent in the affected side, the production of an artificial pneumothorax by puncturing the pleural cavity and introducing N. has been found by some to be of service, but the operation is not a slight one, and ought not to be undertaken lightly. Opinions, both at home and on the continent, vary greatly as to the amount of benefit to be derived from this procedure.

The *gums and teeth* of all phthisical patients must be carefully attended to, as oral sepsis is a very common cause of dyspepsia. Any nasal obstruction should be dealt with, either by the cautery or by the use of an ointment containing menthol and cocaine in vaseline, since there is no commoner cause of laryngitis than a chronic post-nasal catarrh, and mouth-breathing is to be more than usually discouraged for consumptives.

Cough is a symptom which needs careful and diligent treatment. The influence of severe coughing, whatever be the cause, is always adverse to the patient's progress; it destroys his rest, shakes him up, and may induce vomiting, particularly

just after food. One or other of the dry inhalations already mentioned will help towards its dissipation, and the use of a cocaine and menthol ointment for the nose may also be beneficial. Moist inhalations are not to be recommended in phthisis. When the cough is connected with a considerable amount of catarrh in the chest a mixture containing ammonium carbonate (iii grains), spirit of chloroform (xx minims) and camphor water (℥ii) may be used with advantage, while if there is any tendency to asthma, small doses of potassium iodide and tincture of stramonium are often of great service. The bromides frequently relieve a troublesome spasmodic cough. Sometimes, however, in spite of rest, inhalations and the above drugs, the cough does not yield, and one is forced to use opium in some form or another for its alleviation. Pinheroin in doses of a drachm, repeated every three or four hours, is useful, and paregoric is also of service. Where all these fail it may be necessary to give doses of opium sufficient to induce sleep, and under these circumstances the hypodermic injection of $\frac{1}{6}$-$\frac{1}{4}$ grain of morphine is advisable, rather than the tincture of opium or Battley's solution by the mouth.

Treatment of Complications.—*Gastric dyspepsia* may be relieved by the use of sodium bicarbonate (grs. v-x), the heavy or light carbonate of magnesium (grs. x-xv), and the carbonate of bismuth (grs. x-xv) given some fifteen minutes after a meal, and the diet must be carefully regulated. Where dyspepsia exists great attention should be paid to oral cleanliness and to diet.

Diarrhœa, if at all severe, must be treated by bismuth carbonate and pulv. opii in moderately large doses repeated at fairly frequent intervals. The general condition of the patient and the behaviour of the diarrhœa under treatment must determine the dosage. At the same time a semi-fluid diet of milk, milk-puddings and bread should be given. Gentle irrigation of the lower bowel with hot water has a good effect in checking diarrhœa in certain cases.

Tuberculosis of the *bladder*, *kidneys*, and *testicle* must be dealt with surgically, either immediately, or following on a course of treatment by tuberculin, while a *tuberculous pyosalpinx* can be treated only by surgical interference.

Empyema presents certain therapeutic difficulties. If opened and drained it is extremely likely to become chronic, and if punctured and drained by cannula, fluid is liable to collect again rapidly and is extremely easily infected by pyogenic organisms after repeated puncture. It is wise to leave a tuberculous empyema alone as long as is possible compatible with the safety and comfort of the patient, and then to have it dealt with surgically, at the same time instituting a suitable treatment by tuberculin.

For *pneumothorax* and *hydropneumothorax* little can be done save in the way of rest and palliation.

Cardiac failure must be met in the ordinary way, by hot applications over the heart, hypodermic injections of strychnine and ether and alcohol by the mouth if it be acute, while if it be gradual, digitalis and strophanthus may help to ward off the final syncope. The inhalation of oxygen is of use in all cases with failing heart where there is much cyanosis.

When *hæmoptysis* occurs the patient must be kept most rigidly quiet, both physically and mentally, and morphine should be given hypodermically. The administration of turpentine by the mouth or as an ingredient in a solution for inhalation has many advocates. Adrenalin and ergotin are of little value. The application of ice to the chest is recommended, but if, as is usual, it makes the patient fretful, it does more harm than good. Calcium chloride has been given with a view to increasing the coagulability of the blood.

Laryngeal tuberculosis should be treated by absolute rest of the voice—the patient should not be allowed to utter a single word, for weeks, if necessary, or even months—by the use of continuous dry inhalations, and by puncture of the swellings about the cords and of the ulcerated areas, by the galvano-cautery. Cough must be subdued, by opium if need be. A mild "island climate" like Capri, the Grand Canary, Teneriffe, Madeira, or the south-west of England and the Channel Islands is most suitable for those who suffer from laryngeal tubercle. The cold of high altitudes is distinctly against their progress.

When there is much *anæmia*, the condition may be helped by the administration of iron and arsenic when no gastric

discomfort follows on their use. Otherwise it is well to let the anæmia take care of itself, realising that as the patient grows able to overcome the infection it will improve.

Diet.—During the febrile stage of pulmonary tuberculosis the diet should consist mainly of fluids, milk puddings, bread and butter, fish and eggs, the proportion of fluids to solids varying in accordance with the severity of the fever. Unless diarrhœa is troublesome the patient even when there is considerable fever can tolerate a semi-fluid dietary of fairly generous proportions. It must, of course, be limited by the toleration of the patient, and dyspepsia and nausea, which are frequent results of an over-loading of the stomach, should be avoided if possible, and, when they do occur, must be treated with care. When there is no fever, and appetite is good, a generous diet is advisable, which should contain a considerable proportion of fat, in the shape of butter, bacon fat, and milk. Milk should always be "scalded" before being given, as in the present state of our milk-supply it may prove an easy way of adding to the infection from which the patient suffers if it is taken uncooked. Generally speaking, a pint or two of milk should be added to the patient's ordinary dietary, bacon should be eaten frequently with breakfast, and butter ought to be used freely. In other respects the diet should be as reasonably ample as the patient's means permit, and must conform to his personal likes and dislikes. Sanatogen and other proprietary preparations are sometimes of service in neurotic cases, and raw meat juice or sandwiches of raw meat are useful when there is considerable dyspepsia and anæmia. It must be remembered that Paterson gets his excellent results in patients who are doing work on a diet which is within the means of an ordinary working man. In any case it is better to give three good meals a day unless the patient is so feeble as to require frequent small meals, so as to give the stomach a chance of emptying itself properly between meals. If milk is not borne well, a little meat extract given half-an-hour before will often ensure its tolerance.

Epidemiology.—Pulmonary tuberculosis may be said to be endemic in every country which can boast of an advanced civilisation, and it has been spread almost all over the world

by the agency of those who have gone from civilised to uncivilised parts, at the call of business or pleasure. Its worst manifestations are, of course, found in those countries where a cold and damp climate predisposes to all catarrhal affections, and particularly where the presence of large manufacturing centres encourages overcrowding and makes poverty squalid and unclean. All occupations where people are exposed to foul dust-laden air predispose to the acquirement of the disease, and packers in dry goods stores, steel-grinders, stonemasons, sempstresses in large warehouses and workers in asbestos factories, etc., are all more than ordinarily liable to the disease. In short, any conditions of work and life which involve dust-breathing, overcrowding, and all the physical deterioration consequent on small wages, insufficient food and poor lodging, are the causes which above all others favour the acquirement of pulmonary tuberculosis. Considering how common such conditions are, and how widely spread in our streets, houses and food the infecting organism must be, it is less surprising that so many people contract phthisis than that so many escape.

Method of Infection.—It is now generally recognised that the commonest method of infection is by the ingestion or inhalation, by the taking into the mouth or nose, of the B. tuberculosis contained in dust contaminated by the discharges of infected persons. I do not propose to discuss the merits of the inhalation and ingestion theories, but it seems likely that the bacillus gains entry in many cases by the adenoid tissue of the tonsils and nasopharynx, while in other cases it may be swallowed and may enter by some part of the intestinal tract. Animal experiments have shown that the entry of the bacilli through the intestine may produce a pulmonary lesion without the formation of any gross lesion in the abdomen.

Milk infected by the bacillus of bovine tuberculosis, whether in the cow or in its passage from the cow, or contaminated by the bacillus of human tuberculosis at some part of the lengthy and intricate journey which it has to go from the cow to the consumer, is also a fruitful source of infection. Direct contact with those suffering from consumption, through kissing or speaking, also plays some part in the

spread of the disease. Inherited vulnerability to the B. tuberculosis, occupation, unhealthy social surroundings, insufficient food, careless habits of life, and certain other acute diseases, such as whooping-cough, measles, influenza, and pneumonia, are among the chief causes which tend to render one liable to contract the disease.

Period of Infectivity.—It is probable that a patient who suffers from phthisis is infective for at least as long as his sputum shows the presence of the bacilli of tubercle, and this may be for long after it can be detected by staining and microscopical examination, but when it is present only in such small numbers that its detection is very difficult or impossible, the infecting power of the patient must be very small and, if he exercises proper precautions, quite negligible.

Death-rate.—As pulmonary tuberculosis has not been even a voluntarily notifiable disease until very recently, and then only in certain districts, it is not possible to ascertain the mortality among consumptives with anything like accuracy. It is probable that of those who have shewn definite signs of phthisis only a small minority make a complete recovery, although in a much greater proportion the disease is arrested and its course becomes so chronic and protracted that many die from causes only indirectly connected with their tuberculous infection, after the lapse of perhaps twenty or thirty years from the time of its recognition.

Home prophylaxis.—Patients who remain at home after developing phthisis ought to exercise very stringent precautions in their family life. They ought to sleep in a room devoted entirely to their own use, which should have no hangings or carpet, but which should have the floor covered with linoleum, on which may be placed, for comfort's sake, one or two rugs of washable material resembling Turkish towelling. Distemper should be used instead of paper for the walls, and this should be renewed at least once each year. If there is any expectoration it should be disposed of in small paper handkerchiefs which ought to be burned at once. The room should be well ventilated by open windows and an open fire, at least in those countries where the climate permits of heating by this method. Radiators may take the place of fires when

the winter is too cold for the rooms to be kept at a reasonable temperature by the English fire. The room should be frequently disinfected by the formalin spray and formalin vapour, and all bed clothes and washable body-clothing should be formalinised before being sent to the wash. The formalin spray should be used at intervals for the disinfection of outer clothing worn by the patient or stored in his room. The children of the household should be forbidden to kiss the patient or remain long in close contact with him, and especially should they not enter his bedroom or have him in the nursery or schoolroom. When houses are not large enough to ensure such complete isolation the patient ought at least to have a bedroom for his own exclusive use, or, if he is in the country, he ought to sleep out in a garden shelter, and avoid as far as possible close contact with the younger members of the family. Those who have to be in contact with patients suffering from phthisis or who have a bad family history, ought to take special care to preserve their health by living in as good hygienic surroundings as they can, and by reasonable exercise, regular hours and temperance in eating, drinking and smoking, should endeavour to keep their powers of resistance as high as possible. The proper ventilation of houses is most important, and all rooms when not occupied should have the windows thrown widely open, except when a fog settles down over the district in which they are situated, and a window should be slightly open in every room day and night except when raw damp weather prevails. It is true that the bringing up of children in well-ventilated rooms is a necessity for health, but the habit of the open window at night should not be rigid, especially with young children, in towns and in damp bleak districts. It is probable that the constantly open window during the night has something to do with the production of chronic tonsillar inflammation and with the formation of post-nasal adenoid growths. These conditions may arise from quite different predisposing causes, but the bigoted routine of open windows at night may at least encourage their occurrence. In view of modern ideas regarding the methods of entrance of the B. tuberculosis, it is of the utmost importance that tonsillar inflammation and the formation of post-

nasal adenoids should be avoided if possible and promptly dealt with when they arise, since an unhealthy condition of the tonsils and naso-pharynx make the attack of the B. tuberculosis much more likely to be successful. The proper feeding of children, instead of the usual haphazard fashions of child-feeding that obtain so generally, the care of the mouth and teeth, the daily bath and plenty of open-air exercise, combined with scrupulous cleanliness of the house, will do far more to build up a child to resist the attack of the tubercle bacillus, than the blind belief in the necessity for the continuously open window which is made to cover such a multitude of sins of mismanagement in other directions. The Jesuits' saying that if the Society of Jesus has the control of a child till he is seven years old he will not easily drift away from them in adult life, is wonderfully true, and what is true mentally and morally of that saying is equally true in a physical sense of the importance of the first ten years of a child's life with regard to his future constitution. The neglect or misdirection of exercise, careless feeding, lack of care of the mouth, bowels and teeth, and the failure to recognise the slight symptoms which show some inherent peculiarity of metabolism, may lay the foundation, before a child is a dozen years old, of a constitution which will show a resistance to all disease much below the normal, and may be particularly vulnerable to tuberculosis.

Public health administration.—The duties of the Local Authority in respect of pulmonary tuberculosis are ill-defined. In those districts where it is a notifiable disease, inspection of the patient's surroundings and reporting on the housing-conditions and disinfection of houses are done, and in a few places municipal dispensaries for the out-door treatment of cases have been opened. The value of dispensary work cannot be overestimated. It enables the medical officer to discover the districts in which phthisis is rife, so that special efforts can be made as regards the improvement of their sanitation and the disinfection of infected dwellings, while valuable instruction can be given to the patients as to the best means of making them less dangerous to their families. It is possible that the establishment of municipal sanatoria supported by the rates

might be useful at least as educative centres, even though it might be impossible to undertake the "cure" of many cases owing to the time and expense involved and the small number that could be dealt with in a year. "The greatest good to the greatest number" must always be the motto of public health administration, and it would be wrong to devote a year to one patient while half-a-dozen others are deprived of even a preliminary course in the sanatorium. From the point of view of the community it is not within the realms of practical politics to attempt to isolate all those who have phthisis, on account of their numbers and the probable duration of their treatment, but that more should be done than at present is undoubted. Private enterprise does a great deal, but more free institutions are necessary if the war is to be waged satisfactorily, considering how the great majority of consumptives are drawn from the really poor classes.

The advanced case, with cavity formation and profuse expectoration, constitutes, after the early unrecognised case, the greatest danger to the community, and ought to be strictly isolated, either at home or in a house in the country when means permit, or in some institution under the control of the Parish Council or Local Authority where the means of the family are small. Such advanced cases are hopeless as regards cure, and sentiment should no more stand in the way of their segregation than in the case of lepers, while the expense involved could with a little thought be saved out of certain departments and buildings whose upkeep and construction are somewhat too costly as compared with their usefulness. Strict regulations about spitting in workshops, public places and public conveyances ought to be made and enforced with rigour. Much can be done by municipalities and Borough Councils to lessen the incidence of phthisis by the lessening of dust. Streets can be paved with asphalt, thus presenting an impervious surface that can be washed clean at least once a day and watered frequently in dry weather. Wood pavement, and the granite setts with which so many of our northern towns are paved, are both insanitary, especially the latter, because not only is the space between the setts impossible to clean out thoroughly, but the dust derived from the

wearing of the granite is peculiarly irritating and likely to encourage catarrhal affections of the throat and bronchi.

The food supply, also, demands the attention of the local authority. Meat is probably fairly safe as regards infection by tuberculosis, but the butter and milk-supply is still in a most unsatisfactory condition. The whole system, from cow and farm to the attendants in milk-shops and those who distribute milk in our towns, needs careful consideration, and not the least important point is the supervision of the health and homes of those who have to do with the retail trade in food-stuffs.

Chapter XIII.

DYSENTERY.

Synonyms: *Fr.*: Dysenterie.
Ger.: Dysenteria.

Definition. — The name "Dysentery" is given to a group of symptoms:—pain in the abdomen of a colicky character, tenesmus, and the passage of frequent small slimy stools, containing blood, associated with an inflammation of the mucous membrane of the colon. The causal agents producing these symptoms are various, and include the *Amœba dysenteriæ*, the *Balantidium Coli*, the *Bacillus Dysenteriæ* of Shiga, the *Bilharzia Hæmatobium*, and the infecting organisms of *Malaria* and *Kala Azar*. The *B. Pyocyaneus* has also been known to produce dysenteric symptoms. It is not usual to describe the dysenteric symptoms met with in Bilharziosis, Malaria, or Kala Azar, under the head of "dysentery," and the name is usually given to the diseases produced by the Bacillus dysenteriæ discovered by Shiga in 1898, and by the Amœba Dysenteriæ described by Lösch in 1875, the first being called *Bacillary Dysentery*, and the second *Amœbic Dysentery*. It is best to describe them separately, as they are two separate and distinct diseases, with definite clinical as well as causal differences.

Bacillary Dysentery. — *Incubation period*: The incubation is short, probably about 38 hours.

Rash.—No rash has been described as typical of the disease.

Clinical Types.—The disease begins suddenly, with sharp griping pain in the abdomen, tenesmus, and the passage of small mucous stools tinged with blood. The temperature rises to, say, 101° F. or 103° F., the pulse is increased in rate and tends, in some cases, to be small and thready. The patient complains of severe thirst, and the tongue is coated with a white fur. In the very acute cases the patient becomes gravely ill within a couple of days, abdominal pain increases, the mucous blood-stained stools are very frequent, the patient becomes delirious, and may die on the third or fourth day of illness. In cases of less severity the symptoms abate after the first three or four days' illness; pain lessens, the stools become less frequent, the temperature falls and convalescence is established in two or three weeks. In certain cases, however, the disease takes on a much more chronic form after the first acute symptoms subside, and the patient may suffer for many weeks or even months from three or four dysenteric stools in the day, with loss of appetite and progressive wasting. In bacillary dysentery there is little tendency to relapse once recovery has taken place, and abscess of the liver is extremely rare. In a certain proportion of cases a true dysentery may be preceded by some days of intestinal catarrh, during which the stools are copious, bile-stained and watery, but as the attack proceeds the stools become less copious and more frequent, the movement of the bowels is associated with tenesmus, and at last the stools are seen to be typically dysenteric, and the tenesmus and abdominal pain are extreme. Such cases progress much as those already described, save that in this type fever is often very slight, and may be absent by the time the patient comes under observation.

Complications.—*Peritonitis* may occur, either as the result of a spread of the infection through the intestinal wall without rupture, or as a result of perforation. In the former kind, a perityphlitis or periproctitis may occur. The condition is not at all common.

Peripheral neuritis may complicate convalescence. The lower limbs are most usually attacked.

Pleurisy, *venous thrombosis*, and various *pyæmic*

manifestations may occur in severe cases, while *endocarditis* and *pericarditis* are also met with occasionally.

A form of *arthritis* similar to that which may occur in many acute fevers, not definitely rheumatic, but probably of toxic origin, has been observed in some epidemics.

Sequelæ.—The most common sequelæ of bacillary dysentery are *anæmia*, a persistent *dyspepsia*, and irritability of the bowel with a tendency to frequently-recurring *diarrhœa*. The anæmia may be associated with œdema of the feet and legs. A *chronic nephritis* is occasionally met with.

Diagnosis.—An attempt should always be made to isolate the infecting organism from the stools. The B. dysenteriæ is a short bacillus with rounded ends, resembling the B. typhosus in appearance, but being less motile than that organism, and giving a more uniform indol-production. When grown in milk it generates acid at first, but afterwards produces a gradually increasing alkalinity. It does not react to the serum of patients suffering from enteric fever. Agglutination tests should always be made. The serum of patients suffering from bacillary dysentery will agglutinate cultures of the B. dysenteriæ in dilutions of 1-500 up to 1-1000.

The chief clinical distinctions between bacillary and amœbic dysentery are that in the former the onset is usually more acute, and relapse is not nearly so frequent as in the latter, while hepatitis and hepatic abscess are rare complications.

In making a diagnosis of bacillary dysentery it is necessary to exclude diseases in which dysenteric symptoms are a late manifestation, such as malaria and Kala-Azar, and to exclude also diseases due to the invasion of the bowel by the Bilharzia hæmatobium or the Schistosomum Mansoni or Japonicum. Examination of the blood and spleen will serve to exclude malaria and Kala Azar, while the ova of the three Schistosoma are easily recognised in the stools, the S. hæmatobium having a terminal spine, the S. Mansoni a lateral spine, and the S. Japonicum having no spine at all.

Treatment.—It is found that in bacillary dysentery the patient does not respond to treatment by ipecacuanha as do those who suffer from the amœbic infection, and, on the whole,

the best results seem to have been obtained by the use of the aperient sulphates, sulphate of magnesia or sulphate of soda, in doses of thirty grains, either alone or in combination with a few minims of dilute sulphuric acid and tincture of ginger. The doses should be given every hour until fairly free but gentle purgation results. The doses may then be given at longer intervals, but a gentle purgative action should be kept up until some days after the stools are free from mucus and blood. If the stools become watery under this treatment, it should be intermitted.

Calomel, in doses of $\frac{1}{6}$-$\frac{1}{4}$ gr. every hour, may be given until the stools become fairly copious and definitely feculent, and, if tenesmus be severe, it may be combined with small doses of Dover's powder.

Bismuth is of service, combined with opium, in those cases where, although the stools become feculent and blood and mucus disappear, more or less diarrhœa persists. The salicylate is the best salt to use, and should be given in doses of 10-20 grains, every three or four hours. Absolute rest including the use of the bed-pan, and warmth, are two essentials in the treatment of the acute stages of dysentery.

If the dysentery becomes chronic, a small dose of castor oil should be given thrice in the day for about a week, and following this a large enema of water made alkaline by some salt of soda should be given, retained for some minutes, and then allowed to escape thoroughly, after which nitrate of silver injections may be used. The solution for injection should consist of two or three pints of distilled water containing half a grain of nitrate of silver to the pint. The injection should be made by means of a long, soft, indiarubber tube, passed as high as possible without forcing and without kinking. The solution must be allowed to run in by gravity, and not forced in by a syringe, and the patient should retain the injection as long as possible, lying on the abdomen. The injections may be repeated every two or three days for a fortnight or three weeks if they appear to have a good effect, but if they should produce any marked irritation or any aggravation of symptoms they should at once be discontinued.

The Plombières douche, or a course of the waters of Vichy, Kissingen or Carlsbad may also be employed in the treatment of chronic bacillary dysentery.

Diet.—During the acute stage the diet must be fluid and bland, consisting of milk diluted with barley-water or rice-water and whey. This fluid dietary should be maintained for a few days after all acute symptoms have subsided, and at the end of that time a mixed diet should be resumed with the utmost caution, much more careful graduation being needed than in enteric fever, or even cholera. Alcohol should be forbidden for some time after recovery is apparently complete. When the disease has become chronic, the meals should be small and should consist of light easily-digested food.

It is the practice to recommend a diet which excludes beef, mutton, cheese, bread, and coarse vegetables, but a large number of cases will be found to do better, in the chronic stage, if their dietary includes a lightly-done chop or piece of fillet-steak; and bread, if eaten rather stale and chewed almost to a liquid consistency, does not appear to do harm.

Epidemiology.—Bacillary dysentery occurs in epidemic form all over the world, and is common in Japan and the United States. It may break out in institutions, particularly in asylums. The catarrhal, croupous and diphtheritic dysenteries are probably all bacterial in origin.

Method of Infection.— The causal agent of dysentery is contained in the stools, and the alvine evacuations must therefore be regarded as infective. It is possible that the B. dysenteriæ can be spread by the water supply, but it is more probable that it is spread by infected dust in unclean districts and carelessly-tended buildings.

Period of Infectivity.—It is well to regard patients suffering from bacillary dysentery as infectious until all intestinal symptoms have disappeared, and until examination of the stools fails to reveal the presence of the specific organism.

Death-rate.—The death-rate varies very much in different epidemics, and may range from about 3 per cent. to 15 per

cent. in different countries and at different times. It has been put down in Japan as about 7 per cent. on an average.

Home Prophylaxis. — All cases of bacillary dysentery should be isolated with great strictness, whether they occur in institutions or at home. If there is reasonable accommodation in the patient's own house there is no need to send him to hospital, but he must have a room devoted entirely to his use. The attendants should take the same precautions as in dealing with enteric fever as regards their personal cleanliness and the disinfection of the stools and clothing with carbolic acid, "Co-fectant" or formalin. The room and house generally must be disinfected at the end of the illness.

Public Health Administration.—Care should be taken by the authorities to see that all patients who are suffering from bacillary dysentery are properly isolated and that, when the disease appears in an institution, proper means are taken to recognise the condition and to deal with it when it arises. Households in which it appears should be encouraged to disinfect properly, and should be aided by the Local Authority when their means are such as to make proper disinfection difficult. It may be necessary to isolate cases of bacillary dysentery in hospital when an outbreak occurs in an over-crowded and poverty-stricken district, and also to undertake cleansing and disinfection of the district on a somewhat extensive scale.

Amœbic Dysentery.—*Clinical Types.* — The onset of amœbic dysentery may be sudden and acute, with some fever, acute abdominal pain and the passage of frequent mucous stools tinged with blood accompanied by much straining, without there having been any premonitory symptoms beyond a few hours' malaise. In such acute cases, sloughs, sometimes of considerable size, are often passed. Occasionally, after the separation of the sloughs, extensive ulceration of the colon remains, and the patient suffers from severe diarrhœa, emaciates rapidly, and may die in a few months. Sometimes the attack is so acute and severe that the patient dies from asthenia and cardiac

failure after a week's illness. The majority of acute cases of amœbic dysentery, however, clear up in a few weeks, and complete recovery takes place. In a certain proportion, however, the disease gradually assumes a chronic form, and is liable to frequent relapses. In acute amœbic dysentery the abdomen is usually tender, and there is often an enlargement of the liver, with tenderness in the hepatic region.

The commonest mode of onset of amœbic dysentery, however, is not acute, as described above, but is insidious, and a sub-acute form of the disease develops, showing little fever and comparatively slight abdominal pain, with the passage of a moderate number of blood-stained mucous stools and considerable tenesmus. Such sub-acute cases may clear up completely after a few weeks' illness, but in a great number of them the disease becomes chronic and the patients have periods of comparative, sometimes almost complete, quiescence alternating with exacerbations, during which abdominal pain, frequent mucous blood-stained stools and much tenesmus may again appear, while there may also be some fever. This condition of alternating relapse and quiescence may persist for many months, and even for some years. In many cases the patient suffers alternately from obstinate constipation and severe diarrhœa. In a considerable proportion of such cases the patient feels comparatively well, at least in the earlier stages, and maintains nutrition to a surprising degree, but unless the disease is checked, the chronic ulceration of the colon may extend to all parts of the intestinal tract and a destruction of the digestive glands occurs which makes nutrition impossible, and the patient gradually wastes and dies of asthenia. Such patients have a small and capricious appetite. They suffer much from chronic dyspepsia, and sometimes pass their food by the rectum quite unaltered. They are troubled with flatulence and frequent attacks of diarrhœa, and the tongue is red and glazed, or ulcerated and tender.

A *latent form* of amœbic dysentery must be mentioned, in which there are no definite dysenteric symptoms, but in which the patient may suffer from repeated attacks of watery diarrhœa or slight attacks of diarrhœa alternating with

constipation. Again, the first indication of illness may be the occurrence of hepatitis with or without abscess, and Leonard Rogers has found *post mortem* distinct evidence of dysenteric ulceration in the cæcum and ascending colon in patients who had not suffered from any intestinal symptoms. This type is of interest in connection with the occurrence and treatment of hepatitis and hepatic abscess.

Complications.—Of all the complications of amœbic dysentery *hepatitis* and *hepatic abscess* are the commonest. A large and tender liver is quite a usual accompaniment of an acute amœbic dysentery, but the hepatitis may subside with the dysenteric attack, and may not again declare itself. On the other hand, it may appear at varying periods after the attack of dysentery has apparently subsided, and is of common occurrence during the course of a chronic attack of amœbic dysentery. Hepatitis is indicated by some enlargement of the liver with pain and tenderness in the epigastrium and in the hepatic region generally. There is in most cases some irregular intermittent or remittent pyrexia. When hepatitis is suspected, a blood-count should be made, and the presence of a leukocytosis, varying as a rule between 12,000 and 20,000 per cubic millimetre, is at least strongly suggestive of the existence of hepatic inflammation. Hepatitis, if allowed to progress untreated, not infrequently proceeds to the formation of an hepatic abscess. The patient emaciates, suffers from chill and cold sweats, particularly at night, and may be troubled with a short dry cough, or rheumatic pains with swelling of the feet and hands may be present. Pain in some part of the hepatic region is very common, and a limited area of tenderness on pressure may be a valuable aid in the localising of the abscess. In a certain proportion of cases pain in the right shoulder or in the region of the right scapula may be present, and the pain sometimes tends to travel down the right arm. The liver dullness may be increased upwards or downwards, or in both directions. Occasionally its extension is limited and indicates the position of the abscess. If there is no operative interference, the patient may die of toxæmia without rupture of the abscess, or the abscess may burst into the lung or pleura or into the stomach,

intestine, peritoneum, lumbo-iliac region or pericardium. In some cases rupture is followed by spontaneous cure.

Hæmorrhage from the intestine is another complication which may be dangerous, but it occurs in only a small proportion of cases.

Perforation of the intestine through a dysenteric ulcer has occasionally been seen.

Gangrene of the mucous membrane of the colon sometimes occurs in severe ulcerative cases, and when it does occur the stools consist of dirty fluid like "flesh washings." A "coffee-ground" material deposits after they are allowed to stand for a time, and they have a most offensive smell. Sometimes large sloughs of mucous membrane are recognisable in the stools, occasionally of a tubular form. The patient sweats profusely and becomes rapidly weak, he develops a low muttering delirium, the heart fails and death is the almost invariable termination of the case.

Sequelæ.—Intestinal obstruction from cicatrisation of the gut has been known to occur as a sequel of chronic amœbic dysentery, but the most troublesome sequela is the *chronic dyspepsia*, the *tendency to diarrhœa*, and the *malnutrition* which so frequently follow a chronic attack. It is possible that the atrophy of the secreting structures of the whole gastro-intestinal tract with ulceration and tenderness of the tongue may be the result of an attack of "Sprue" taking effect on an already weakened intestine. Patients who develop this "sprue"-like condition invariably die sooner or later from the effects of malnutrition.

Diagnosis.—The diagnosis of amœbic dysentery depends on the discovery of the amœba dysenteriæ in the stools. If some of the fæces of a person suffering from dysentery be spread on a slide and examined microscopically on a warm stage, the amœbæ are seen as small greenish translucent bodies about four times the size of a red blood-corpuscle. They have a clear outer rim—the ectosarc, and a finely-granular internal mass—endosarc, and show, as a rule, one or two contractile vacuoles. They usually contain the remains of red blood-corpuscles, crystals of various kinds, and bacteria. On

the warm stage they exhibit the crawling movement with protrusion of pseudopodia, which is the characteristic of amœbæ in general. When dried, the amœba of dysentery takes on a very resistant form, and in this state is capable of resisting the gastric juices.

Especially in acute cases, the diagnosis is usually easy, but it must be remembered that the presence of the Schistosomum hæmatobium, the S. Japonicum, and the S. Mansoni, malaria, Kala Azar, hæmorrhoids, tumour of the colon or sigmoid flexure, may all give rise to dysenteric symptoms, and care must be taken to exclude them in arriving at a diagnosis.

Treatment.—Absolute rest and careful dieting are necessary in all cases of amœbic dysentery, even in those which appear to be chronic. Among drugs, *ipecacuanha* holds the foremost place, both in the treatment of the dysentery itself and the concomitant hepatitis. It should be given in large doses—20-30 grains twice in the day being necessary to produce the desired effect. It is best given in the form of freshly-made pills, or in gelatine capsules, or as a bolus in rice-paper. On account of its emetic action certain precautions must be taken in its administration. It must be given on an empty stomach, and it is well to withhold all food for three hours before giving the ipecacuanha. Thirty minims of chlorodyne or twenty minims of laudanum should then be given in an ounce of water and a mustard poultice applied to the epigastrium. About twenty minutes later the patient should take the ipecacuanha and lie flat on the back without moving or speaking for some hours. He must not swallow his saliva, but should indicate to his attendant when he wishes to get rid of it and, with as little movement as possible, spit it into a towel held for him for the purpose. Nausea must be strenuously resisted. Five to eight hours after taking the ipecacuanha, and after nausea has disappeared, the patient may begin to take small quantities of food of a fluid or semi-fluid character, and feeding with small quantities should be continued for some five hours, at the end of which everything should be withheld from the stomach for an hour or so and ipecacuanha given again, the same

precautions being observed as after the first dose. It is not so necessary as before the first dose to withhold food for some hours before its administration for the second time, but the precautions to avoid nausea should be as strict. Ipecacuanha ought to be repeated once or twice a day for at least a week after the stools have become copious, feculent and yellow. Diarrhœa is no indication for stopping treatment by ipecacuanha. Some three or four days after the improvement in the character of the stools has been observed, it is best to reduce the dose by 5 grains daily.

Not only is ipecacuanha useful in the acute stage of the disease, but if the disease becomes chronic the large doses should be resumed and given a fair trial before being replaced by other forms of treatment. When hepatitis exists after a patient has had dysentery, or even when hepatitis is present when the patient has had no definite symptoms of dysentery, it is advisable, at least in tropical and sub-tropical countries, to treat the condition by ipecacuanha in large doses for some time after all symptoms have disappeared. The results of Leonard Rogers are very striking, and encourage one to recommend, as he does, that even when a patient suffers from an obscure pyrexia and shows a leukocytosis while he is living or when he has lived in a district where dysentery is common, a course of treatment by ipecacuanha should be instituted when careful examination of the blood and spleen has excluded the possibility of the disease being malaria or Kala Azar. It is probable that, if ipecacuanha in sufficient dosage were more generally used in the treatment of amœbic dysentery and in the treatment of hepatitis of obscure origin, hepatic abscess would be of much rarer occurrence than at present.

When an hepatic abscess has formed, the treatment is purely surgical. Exploratory punctures should be made in all cases where there is any doubt as to its localisation, and search should not be stopped until five or six punctures have been made. But it is well to add that exploratory punctures should never be made, unless the abscess is very apparent, until after some days' treatment with ipecacuanha. After

the abscess has been localised it should be punctured, and thorough drainage established, after the method described in detail by Manson.

Where persistent vomiting makes treatment by ipecacuanha impossible, one is compelled to fall back on the use of the aperient sulphates and calomel, as described under the heading of "Treatment" in the section on bacillary dysentery.

In *chronic amœbic dysentery*, if the patient has been previously treated by inadequate doses of ipecacuanha, or if some time has elapsed since the ipecacuanha treatment was stopped, this drug should be given in doses of 30, 25, 20, 15, 10, and 5 grains on six successive nights, and the patient should thereafter be put on small doses of castor oil thrice daily, the diet being carefully limited to milk and barley-water. After this he should be given some weeks' treatment with salol or small doses of calomel, and, in addition, enemata of salt and water may be given with advantage.

If these means fail, the large injection of a weak solution of nitrate of silver as described in the section on "Bacillary Dysentery" should be tried, or similar large injections containing quinine in solution of a strength of 1-5000 to 1-2500 instead of the nitrate of silver may be used, and retained for 15 minutes. Milk and weak solutions of sulphate of copper or tannin are also recommended. Straining and abdominal pain may be relieved by small starch and opium enemata.

The *constipation* which is not uncommonly a troublesome sequel of dysentery should be treated first by repeated enemata of water made slightly alkaline, or by injections of linseed infusion or barley-water. A teaspoonful of castor oil twice or thrice a day is a useful method of treatment, and may be supplemented by an occasional soap or glycerine suppository. A course of Carlsbad or Marienbad waters is also effective in many cases. The greatest care to avoid chill should be taken by those who have recently had dysentery or who suffer from chronic dysentery. Cold baths should not be taken, and cold and damp climates must be regarded as dangerous.

Diet.—The same principles of diet apply to amœbic as to bacillary dysentery, and alcohol should be equally avoided

during an attack and for some time after its termination, whether it be acute or chronic.

Epidemiology.—Amœbic dysentery is endemic in many parts of the world. It is found in the southern parts of the United States of America, in the West Indies, in Egypt, Arabia, Africa, China, India and the warmer parts of the globe generally. It is not found, save in the form of occasional imported cases, in the more temperate latitudes. It occurs in warm countries also in a sporadic form.

Amœbic dysentery not infrequently coexists with a bacillary dysentery.

Method of Infection.—Amœbic dysentery is usually a water-borne disease, and contaminated wells and polluted rivers are the commonest means of its conveyance, but it may also be spread by dust contaminated by the evacuations of those suffering from the disease.

Period of Infectivity.—It is right to regard a patient as infectious until at least seven days after the amœba has apparently disappeared from the stools.

Death-rate.—As in bacillary dysentery, this is very difficult to gauge accurately, and, from the study of statistics from various parts of the world, seems to vary from 2-40 per cent in different outbreaks according to the place and race of those attacked. In the East, the natives show a higher mortality than Europeans, probably largely on account of their different hygienic surroundings and less careful feeding.

Home Prophylaxis.—All patients who are suffering from amœbic dysentery should be isolated. Extreme care must be taken by those who are still healthy to avoid contamination by the dried stools of those suffering from the disease, either through the medium of clothing or of vessels. The amœba in its moist "vegetable" stage does not seem nearly so capable of producing an attack of dysentery as when it has assumed its dry and extremely resistant form. Great care must be taken, therefore, to keep the patient and his bedclothes clean, and the stools ought to be immediately disinfected by formalin, "Co-fectant," or some crude preparation of phenol. The attendants must exercise the most scrupulous care as

regards personal cleanliness, and pay particular attention to the hands and nails, bathing them with a solution of permanganate of potash after washing. At the termination of the case the sick-room and everything which has been in contact with the patient should be thoroughly disinfected.

In every district where dysentery is endemic the greatest care should be taken to insure the purity of the water supply, and all water should be boiled before drinking. The house must be well-kept, and not permitted to harbour dust or dirt. The greatest care must be taken to keep the bowels regular, to avoid chill, unwholesome food, and intemperance in eating or drinking; in other words to avoid everything which will tend to encourage catarrh of the gastro-intestinal tract.

Public Health Administration.—This resolves itself into seeing that the water-supply is pure, that the disposal of sewage is safely and efficiently done, and that household cleanliness is as perfect as possible. All collections of rubbish must be disinfected and removed and all receptacles for rubbish frequently lime-washed.

The disinfection of houses where dysentery has occurred and of all articles which have been in contact with a patient should be undertaken, while those who are suffering from the disease must be strictly isolated, either at home, if their accommodation is sufficient, or in hospital if it is not.

Chapter XIV.

KALA AZAR.

Synonyms. — Dum-dum Fever, Burdwan Fever, Black Sickness, Sirkari disease, Sahib's disease, Tropical Splenomegaly.

Definition. — A specific infective disease, characterised by a chronic course, irregular pyrexia, enlargement of the spleen and liver, progressive wasting and anæmia, with, in many cases, an unusual deposition of pigment in certain parts of the skin. The disease is presumably caused by a protozoal organism belonging to the genus *Herpetomenas* which is present in the blood, particularly in the spleen and liver, in the form of the "Leishman-Donovan bodies," discovered by Leishman *post mortem* in 1900, and in the splenic blood during life by Donovan in 1903.

Incubation Period.—The incubation period of Kala Azar is difficult to determine. Manson quotes the case of an Englishman who was previously in perfect health, but who fell ill of Kala Azar within ten days of his coming to a district where the disease was endemic. It is probable, however, that the usual incubation period is considerably longer.

Rash.—No eruption has been described as typical of the disease.

Clinical Types.—Kala Azar may have an *acute* or an *insidious* onset.

In cases with an acute onset, the disease may be ushered in by rigors, repeated daily perhaps for several days, and often recurring at intervals throughout the attack. The fever is usually of a high continued or high remittent type at the

commencement of the attack, but tends to show greater remissions as the attack proceeds, and may be quite definitely intermittent in character. In such cases, the fever continues for some two to six weeks, when a period of complete or almost complete apyrexia begins. This period of apyrexia lasts for a very variable time, from a few days to some weeks, and is followed by another febrile movement, not usually so severe as the first. The alternation of fever with periods of normal temperature may persist for some months, but sooner or later the fever assumes a continuous low remittent or intermittent type, and the patient presents the emaciated appearance so usual in the later stages of the disease.

Rogers points out that the remittent type of fever, especially if it be fairly high, shows a rise of temperature twice in the twenty-four hours with wonderful regularity in a striking number of cases. This "double remittent" type of fever he considers so peculiar to Kala Azar as to be in itself strongly suggestive of the presence of the disease.

From the onset of fever the spleen enlarges, showing, at first, fluctuation in size more or less comparable with the variations in the febrile movement, but soon exhibiting permanent and progressive enlargement.

The liver also enlarges in from 40 to 70 per cent. of cases as the disease progresses.

Headache, nausea and vomiting are not at all constant even during the period of invasion, but occur in a relatively very small number of cases as compared with other infectious fevers.

In cases where the onset of the disease is insidious, the patient may present himself as suffering from general malaise and weakness of gradual onset, and is found to have a pyrexia of varying intensity, perhaps of the lower remittent or "double-remittent" type or of a low continued type, while the spleen may be enormously enlarged. The splenic enlargement may be out of all proportion to the apparent duration of his illness, and is suggestive of a prolonged infection, during the earlier stages of which fever and other constitutional disturbances may have been so slight as to escape attention.

In all cases, whether the onset has been acute or not, the *course of the disease is chronic*, and the patient may drag out an enfeebled existence for months, or even years, suffering from a low type of continued remittent or intermittent fever with occasional periods of apyrexia, and enlargement of spleen and liver with anæmia and emaciation, until he either recovers or, as is much more common, dies from some intercurrent disease or from sheer asthenia. *Petechiæ* may appear on the skin, especially in the region of the axilla, and bleeding may occur from the gums, nose or intestine.

The *appetite* and *digestion* usually remain wonderfully good even in the later phases of the attack.

Anæmia becomes marked as the disease progresses, but the reduction in the number of red cells may not be extreme. The striking point about the blood condition is the leukopænia which is found, and in this leukopænia the polymorphs are reduced in number out of all proportion to the mononuclear cells, so that a percentage estimation of the white cells will show a relative increase of mononuclears as compared with polymorphs.

In association with the anæmia, *hæmic murmurs* are frequently heard over the præcordium, and *œdema of the feet and legs* is not uncommon.

An irregularly distributed pigmentation of the skin, like large deeply-coloured freckles, is often seen on various parts of the body, with a tendency to be most marked in the flexures. The skin generally becomes dull and earthy-looking, and the hair grows dry and brittle.

At all stages of the disease *sweating* is common during any remission of the fever.

Complications.—*Diarrhœa* is not infrequent in the chronic stage of Kala Azar, and during its occurrence the spleen may be for a time greatly reduced in size. *Dysentery* occurs in a certain proportion of cases, more commonly in natives than in Europeans, and very frequently proves fatal. The dysentery is usually of the bacillary type. *Phthisis*, *hæmorrhages* of various kinds, and *pneumonia* are met with as terminal complications of the disease, but not with the same frequency as many septic conditions, of which the most important are

cancrum oris, *sloughing* of various parts, and *middle ear suppuration*. Of these complications, cancrum oris seems to be the most common and the most fatal, and pneumonia follows next in frequency and danger. Sloughing of the tissues of the mouth is specially common as a terminal event in the Soudan. *Bronchial catarrh* is rare, especially in the earlier stages of the disease, and is found mostly as a basal condition in very asthenic patients. *Ascites* may be met with as the result of cirrhosis of the liver following on long standing chronic enlargement.

Diagnosis.— It is very difficult to distinguish an early case of Kala Azar with high remittent or continued fever from enteric fever and remittent malaria. If the pyrexia is of the "double remittent" type the disease is probably Kala Azar, and the absence of any pulmonary or bronchial catarrh would be evidence against its being enteric fever, but Widal's test and the examination of the blood for the parasite of malaria and the Leishman-Donovan bodies must be undertaken to confirm the diagnosis. In both enteric fever and Kala Azar a leukopænia is the rule, but this is much more marked in the latter disease, and the leukopænia of enteric fever does not show the marked diminution in the polymorphs and the relative increase in mononuclears which is met with in Kala Azar. In the early stages of Kala Azar, however, the leukopænia may not be typical, so that it may be necessary to depend on the examination of the blood for a diagnosis, and, when repeated examinations of the peripheral blood has failed to reveal the presence of the Leishman-Donovan bodies and where there is no definite evidence of malaria or enteric fever, one may be compelled to resort to puncture of the spleen or of the liver, if it be also enlarged, for the recovery of the bodies. In the early stages of the disease puncture of the spleen is a comparatively safe operation, but even in the early stages the coagulability of the blood should be estimated, and if the coagulation-time should exceed five minutes, as estimated by Wright's coagulometer, the operation should not be undertaken, as death from hæmorrhage has not infrequently followed on splenic puncture. This accident is not so likely to happen in the early as in the late stages of the disease where

the coagulability of the blood is always low, and it is fortunate that it is only in the early stages that the operation is likely to be necessary, since it is at this time that the Leishman-Donovan bodies are apt to be difficult of recovery from the peripheral blood. In the later stages of the disease, it is usually possible to recover them easily from the peripheral blood, or if this is impossible, they may be recovered from the enlarged liver. It must be remembered that puncture of the liver is a much safer operation than puncture of the spleen.

Just before the liver or the spleen is punctured it is best to give the patient a dose of 20 to 30 grains of calcium chloride, as recommended by Rogers, in the hope that it may increase, even temporarily, the coagulability of the blood.

Kala Azar in its later and most typical stages is apt to be confounded with malarial cachexia; but the failure to find the malarial parasite, the failure of the quinine test, and the typical kind of leukopænia present, all aid to the formation of a presumptive diagnosis of Kala Azar, while the Leishman-Donovan bodies can usually be discovered in the peripheral blood, and in the liver after puncture. It is wise not to attempt splenic puncture in the late stages of the disease on account of the fatalities which have attended the performance of the operation, even after precaution has been taken to guard against accident. The enlargement of the liver commonly present in the later stages, and the freckling of the skin also help to distinguish the disease from malaria.

Short of the discovery of one or other of the infecting organisms, the differentiation between Kala Azar and trypanosomiasis may be a matter of great difficulty, if not impossibility, in those countries where both diseases occur in endemic form.

The "Leishman-Donovan bodies" are found in the endothelial cells of blood-vessels, and are seen in the large mononuclear cells in the pulp of the spleen, the liver, the bone-marrow, the kidney, in papules and ulcers on the skin, and in petechiæ. In the peripheral blood they are found in leukocytes, both polymorphonuclear and mononuclear. Stained by Leishman's modification of the Romanowsky method, they appear as small oval bodies about 2 to 4 μ in diameter.

They show two lilac-coloured chromatin masses enclosed in protoplasm which stains a faint blue colour at the periphery of the body. The larger and less deeply stained mass is the nucleus, and the smaller and more deeply stained mass, which is rod-shaped and placed perpendicularly or at a tangent to the nucleus, is the micronucleus or blepharoplast. Cultivated outside the body in the acid medium recommended by Rogers, who first cultivated these organisms, the parasites rapidly enlarge, assume a pyriform shape and develop a flagellum. They grow best at a temparature of 20°-22° C.

Treatment.—The treatment of Kala Azar has been singularly unsatisfactory. Arsenic seems to be of no avail, even in the form of Atoxyl, and it is not probable that the preparation of Ehrlich and Hata known as "606" or "Salvarsan" will give better results. Manson has seen no good results from the use of quinine and, indeed, believes that it may do harm. Rogers, on the other hand, considers that quinine by the mouth should be pushed in doses of 30 to 60 grains in the day, more especially if the case is a comparatively early one, for weeks if necessary, and supports his views by his personal experience and by the results obtained by Dodds Price in Assam. It is a difficult matter to give accurate figures regarding the results on account of the extreme chronicity of the disease and the remarkable spontaneous cures which sometimes occur, but the experience of Rogers in the reduction of a high continued or high remittent pyrexia to a slight low remittent pyrexia after the use of large doses of quinine, would make one rather believe that the drug is worthy of serious trials in suitable dosage, especially when the disease has been diagnosed in an early stage.

A patient who has developed Kala Azar should be moved as soon as possible to a warm healthy climate and put under as good hygienic conditions as possible.

Diet.—A diet as generous and varied as lies within the patient's means and physical tolerance should be given in Kala Azar, save when the occurrence of high pyrexia, pneumonia, or dysentery requires its modification.

Epidemiology.—Kala Azar is endemic in Madras, Lower Bengal, Assam and in the United Provinces of Agra and

Oudh, and has slowly spread up the valley of the Brahmaputra in Assam in epidemics of great severity. The disease is clinically identical with an epidemic which raged in Lower Bengal between 1854 and 1873, and was called Burdwan Fever. It is probable that the disease was introduced into Assam from this epidemic in Bengal. As the epidemic spread in Assam it tended to die down in places which it had previously devastated, and, as is the case in Lower Bengal, sporadic cases now occur in these districts, although the disease no longer appears in epidemic form there. Sporadic cases occur also all over the Eastern side of India, especially in Madras, Lower and Western Bengal, Agra and Oudh. There seems to be no difference in the susceptibility of the sexes to Kala Azar when both are equally exposed to infection. Children take the disease in large numbers.

The native and Eurasian population who live under the worst hygienic conditions are attacked with greater frequency than Europeans, and it is interesting to note that Europeans are attacked, other things being equal, almost in proportion to the shortcomings of their hygiene. Another fact of interest regarding the infection of Europeans is that Kala Azar attacks those who have lived for many years in India rather than newcomers to the country.

Kala Azar tends to be more common in the "cold season" in India, and is always more prevalent after a succession of prolonged "cold weathers."

In recent years Kala Azar has been discovered to be epidemic in certain districts of the Soudan, and deaths have occurred from this disease among both natives and Europeans serving with the Egyptian Army in the more southern limits of Soudanese territory.

Method of Infection.—It is probable that Kala Azar, like malaria, is not directly contagious, but that the disease is carried from person to person, or from soil to man by the intermediary of some biting insect, and the most likely insect is the common bed-bug which is so common in India and Africa. Moreover, the acidity of the bed-bug's stomach seems to favour particularly the development of the flagellated

stage of the parasite, and the way in which the disease tends to cling to rooms and dwellings is also in favour of its being spread by some insect which lives in the house.

Period of Infectivity.—It is well to consider all patients infectious so long as they present the clinical features of the disease.

Death-rate.—The death-rate of Kala Azar varies on an average between 75 and 96 per cent. where the disease is epidemic. Among sporadic cases the mortality may be much less.

Home Prophylaxis.—All cases of Kala Azar should be considered as infectious and should be isolated. No patients in Hospital ought to be allowed to wear their own clothing. All clothing which has been in contact with the patient should be destroyed. The greatest care should be taken to eradicate vermin from the house, especially bed-bugs, and when ordinary means fail a thorough stripping and even the rebuilding of the house should be undertaken. The strictest personal and domestic cleanliness is necessary.

Public Health Administration.—All infected houses and "lines" should be dealt with and if necessary destroyed. As the disease occurs in India and the Soudan there is little difficulty in destroying the flimsy houses and rebuilding in a different place. An energetic campaign ought to be directed against the bed-bug—the houses should be fumigated with burning sulphur or liquid SO_2, beds should be thoroughly washed with a boiling solution of 1-20 carbolic acid or 1-1000 perchloride of mercury, and all clothing and blankets should be destroyed. Habits of personal and domestic cleanliness should be inculcated amongst the natives as far as possible.

FEVERS OF UNCERTAIN BACTERIOLOGY.

Chapter XV.

SCARLET FEVER.

Synonyms: Scarlatina.
Fr.: Scarlatine.
Ger.: Scharlach.

Definition. — An acute specific infectious fever, characterised by sudden onset, a characteristic eruption, and a well-marked lesion in the throat.

Incubation Period.—The incubation period of scarlet fever is short, varying between one and seven days. The usual incubation is 2-4 days.

Rash.—When typically developed the rash of scarlet fever is easily recognised, but in none of the eruptive fevers does the rash present so many variations and modifications, both in character and distribution, as in scarlatina. The rash is essentially a punctiform erythema, consisting of small closely-set bright red points on a ground of paler red. It appears about twenty-four hours after the onset of symptoms, becoming visible first on the sides of the neck and upper part of the chest and spreading gradually over the whole body, involving the legs and feet last of all. While it is, in typical cases, very general in its distribution, the palms of the hands and soles of the feet do not show punctation, although they may be deeply flushed. The back and upper part of the chest are often so deeply flushed that the punctæ cannot be readily distinguished, while on the abdomen the punctæ can often be seen as bright points on a skin that is, perhaps, only rather yellower than normal, or only faintly flushed. On the forearm and front of the legs, the rash is seldom so

uniformly distributed as elsewhere on the body, and tends to assume a patchy and rather indeterminate character, while in these regions, also, it is frequently quite definitely papular. This papular character is particularly evident on the front of the legs about the shins, and may help greatly in the diagnosis of a case of scarlet fever when the patient has come under observation after the rash has begun to fade. Many people describe the face in scarlet fever as being merely flushed and not invaded by the rash, but in most cases with a well-developed rash it will be seen that the punctiform erythema does invade the face in the lateral aspect, spreading up a little from the angle of the jaw, and the forehead is also frequently invaded, although the malar region shows no punctæ but is merely flushed. Pressure of the fingers over an area of skin invaded by the eruption temporarily blanches the part, but the marks left by the fingers are distinctly reddish yellow and not white like similar marks left after pressure over a flushed area in health.

The rash also invades the soft palate, and, indeed, this may be the first situation where it is visible. In addition to the usual faucial and tonsillar congestion the punctate character of the rash is sometimes very striking on the soft palate and may aid considerably in the early diagnosis of a case of scarlatina.

Red staining, which does not disappear on pressure, is often visible along the lines formed by the natural folds of the skin, particularly in the neck and in the flexures of the elbow and knee.

A miliary eruption frequently appears as a result of the hyperæmia of the skin, and numberless tiny vesicles are visible, particularly on the neck and chest, apparently over the site of the punctæ. These dry up and rupture, leaving small pin-point openings which may be the starting point of desquamation.

The scarlatinal rash begins to fade, as a rule, about the fourth day, and has mostly disappeared at the end of a week.

The eruption is, however, not always so typical. It may appear only on the neck and chest, leaving the rest of the body free; it may present, in certain grave cases with severe early

toxæmia, a dusky blotchy appearance with no regularity of distribution and with none of the punctate character met with in the typical eruption; in some malignant cases it is altogether absent; in many mild cases it is represented by a faint blush, limited to the neck, back and chest, or of fairly general distribution, which may fade in a few hours leaving no apparent trace behind. In the mild cases, however, while the rash has been faint and evanescent, papules may persist in the region of the shins which may afford a certain help in diagnosis. In a few cases the blotchy character of the rash which is so common on the legs is apparent also on the thighs, arms and back, and the case may be extremely difficult to distinguish from a rather aberrant type of measles.

In certain severe toxic cases petechiæ appear, either alone representing the rash, or in association with a badly-developed and dusky punctiform erythema of quite irregular distribution.

As the rash fades, or just as it has faded, *desquamation of the cuticle* occurs. This begins as a powdery desquamation on the face and lobes of the ears somewhere about the fourth or fifth day after the appearance of the rash. Then small "pinholes" appear on the neck, upper part of the chest and upper arm, usually from the seventh to the tenth day. The process spreads downwards over the trunk and arms and the hands begin to show desquamation about a fortnight after the onset of illness and the feet about a week later. As a general rule desquamation is complete, save on the palms and soles, about four weeks after the onset of the disease, and the palms are usually free at the end of the fifth week. The tough skin of the soles of the feet, however, has seldom completely separated until the end of the sixth or eighth week, and may not desquamate completely until the tenth or twelfth week of the disease. Occasionally the skin separates in large sheets on the back and, still more rarely, may be shed from the feet and hands in the shape of complete casts of the extremities, like gloves. After desquamation is complete, a secondary desquamation may occur, either general in distribution, or more commonly confined to the hands and feet.

The dates of desquamation given above are only rough averages. In many cases desquamation may be complete,

save on the hands and feet, within a fortnight, while in other cases, usually mild, desquamation may not appear anywhere until about the fourth or fifth week of the disease. It is sometimes so slight as to be practically imperceptible, and in many mild cases all that can be seen is a little powdery desquamation at the anterior borders of the axillæ, at the root of the neck and in the groins, and a little roughness of the shins with some powdery desquamation between the fingers and between the toes. As is the case with all the manifestations of scarlet fever, desquamation may be so profuse and typical as to be impossible to miss, or, on the other hand, so slight and atypical as to afford no help in the diagnosis of the case, save only in conjunction with other signs and symptoms.

Clinical Types.—It is usual, in describing the various types of scarlatina, to mention the ordinary type, or *scarlatina simplex;* the *malignant type;* the type in which pyogenic manifestations in the throat constitute the chief feature of the attack or *scarlatina anginosa*; and the *mild type.* It must be remembered, however, that although many cases can be accurately classified under one or other of these headings, one meets cases which are on the border line of two classes, and one may have difficulty in labelling them as simple or anginous, as anginous or malignant, as simple or mild, but so long as it is understood that such classifications are used merely for convenience, and are not accurate, it is well to adhere to the accepted grouping of the various types.

Scarlatina Simplex.—The onset is sudden and acute. The attack may be ushered in by headache, vomiting, rigor and sore throat occurring almost simultaneously; or sore throat, with a feeling of heaviness and slight general malaise, may precede the headache, vomiting and sensation of chill by some hours. A convulsion may take the place of rigor in young children. The sore-throat increases rapidly in severity, the tonsils enlarge, the mucous membrane of the nose and naso-pharynx may decome dry and turgid, so that the patient complains of a "swollen" sensation at the back of the nose and probably breathes by the mouth. The tongue becomes rapidly coated with a white fur, and exudate appears on the tonsils.

There is pain and tenderness over the cervical glands, which in most cases can be felt to be slightly enlarged. Pain in swallowing is a common feature of the disease at this stage. Appetite is absent, but the patient feels very thirsty. In about twenty-four hours the rash develops. The appearance of the face is very characteristic. It is flushed save for a circumoral ring of comparative pallor. The eyes are commonly blood-shot, and the punctiform rash is visible on the temples and at the angles of the jaw. Although the eyes are bloodshot, there is none of the lachrymation and photophobia which are so common in measles. The temperature rises quickly to high registers from the commencement of the illness, and the pulse is rapid, full and bounding, the pulse-rate being unusually rapid in proportion to the rise in temperature. The patient may be delirious almost from the onset of the illness and is usually restless and uncomfortable, sleeping only for short periods at a time and complaining of pain in the throat, headache and general uneasiness. In about three days the headache disappears, the throat symptoms abate, the tendency to delirium lessens, the fever shows larger remissions, and towards the end of the first week the temperature falls by rapid lysis, with a corresponding drop in the pulse-rate to normal. As the temperature falls, the swelling and acute congestion of the throat disappear, but a certain amount of undue redness of fauces and tonsils may persist for weeks. The tongue which is at first coated with a thick creamy fur presents, about the second or third day of fever, the typical "strawberry" appearance, due to the projection of swollen papillæ through the fur. As the temperature falls the tongue grows clean, and, after the fur disappears, has a raw rough appearance, with enlarged papillæ projecting from the surface. As desquamation proceeds the tongue very often has a smooth glazed look. In uncomplicated cases of scarlatina simplex the patient's troubles are now mainly over and he has only to look forward to a somewhat lengthy convalescence regulated by precautions for his own safety and against his infecting others.

Scarlatina Maligna presents a very different picture. In its fulminant type a patient may be suddenly seized with

headache, rigor, vomiting and high fever, becoming wildly delirious, and shortly afterwards comatose, and death may ensue within twenty-four hours without the development of rash or any visible throat manifestation beyond a little faucial redness. In some cases vomiting and diarrhœa are the most clamant symptoms and persist till death occurs. The fulminant type is very rare at the present day, but it is occasionally met with. In one case which occurred in my own practice, a child of eight, previously healthy, was infected by her brother who had a very mild attack of scarlet fever, and, four days after the onset of her brother's illness, she was suddenly seized with headache, hyperpyrexia and severe vomiting. She rapidly became comatose, and died in twenty-six hours after the first appearance of fever and headache. In this case the fauces and tonsils were distinctly congested, the tongue was thickly coated, and two hours before death some deep livid blotches appeared about the neck and anterior borders of the axillæ. An examination of the body was made *post mortem*, and no meningitis or other gross lesion was found.

In other malignant cases death is delayed for some days, but few patients who are attacked by a truly malignant form of the disease survive beyond three days. The striking feature in such cases is the apparent insignificance of the local lesion in the throat. The fauces and tonsils may be congested, but there is little swelling of the parts and no exudate. If the patient survives longer than twenty-four hours an imperfectly developed rash may be visible, affecting the neck, chest, back, groins and thighs, showing little of the punctiform character which is so typical in the properly-developed rash, but being rather blotchy and livid, with petechiæ at the axillary borders and in the groins. Sleeplessness and a restless delirium may be troublesome in these cases, which are invariably fatal. Convulsions may occur at frequent intervals and vomiting may be almost constant. Profuse diarrhœa is sometimes met with.

In yet another kind of malignant attack, fever may be moderate and there may be little restlessness and delirium, but the heart is evidently profoundly poisoned from the first

by the toxins of the disease. The patient has a rapid, soft, irregular pulse, the ventricular sounds are faint at the apex and practically inaudible at the base, the skin presents a livid pallor and respiration tends to be "sighing" in character. In such cases death occurs about the fourth or fifth day. Vomiting and diarrhœa are often severe.

Scarlatina Anginosa, or septic scarlet fever, is the name given to that type of case in which the throat manifestations are unusually severe; in which, if the patient lives long enough, there is sloughing of the tonsils, uvula or fauces generally, and in which abscess in the tonsil, post-pharyngeal abscess, "collar-neck" and other manifestations of an acute pyogenic infection are frequently met with.

The onset of such a case is commonly severe and acute. From the commencement the throat is very markedly involved; the tonsils enlarge, sometimes enormously, the uvula and fauces generally are swelled, and the whole throat has an angry look and is usually deep purplish-red in colour. The tonsils may be covered with much mucopurulent exudate, or may appear smooth and glazed, with only a small amount of exudate on their surface. The glands at the angle of the jaw, and in the cervical region generally, are swelled, painful and tender, and the skin overlying them may very soon become reddened and infiltrated. In such cases the rash is commonly profuse and well developed, perhaps a little darker than is usual in a simple case, but it may come out in patches, and be slow of appearance. It is not infrequently of a rather livid colour and may show a tendency to be "fixed" in parts, and definite petechiæ may be seen.

During the first few days of a severe attack of septic scarlet fever, nervous symptoms are often very urgent. The patient is sleepless and delirious at night, restless and disturbed during the day by pain in the head and throat and by the swelling of the tonsils and uvula. The greatest trouble may be experienced in procuring rest for him, and no pains must be spared by the physician to induce sleep and make the patient more comfortable, as it is largely on the success of his efforts in this direction that the life of the patient depends.

There is always a certain amount of sloughing of the tonsils, and the process is in some cases very extensive, involving both tonsils, the uvula, the pillars of the fauces and even the soft palate. An abscess may form in the substance of the tonsils leaving a ragged foul ulcerating cavity where it bursts or is opened. Sloughing or abscess formation appears about the fourth or fifth day, and several weeks may elapse before the throat is completely healed.

The temperature as a rule runs high in scarlatina anginosa, and fever is of longer duration than in a simple case. Even without the occurrence of any definite complication the temperature does not fall to normal about the end of the first week but fever may continue for ten days to a fortnight, or even longer, depending largely on the condition of the throat.

Death may occur during the first week, before there is much ulceration of the tonsils, or it may occur during the period of sloughing and abscess formation, or it may result from one or other of the more serious complications, which are particularly liable to appear in connection with the anginous form of the disease.

Mild forms of Scarlet Fever are met with where the manifestations of the disease are so slight that unless they occur in association with other definite attacks, their recognition is a matter of extreme difficulty. Slight headache and sore throat, with almost no fever, followed on the same day or on the next day by a faint and transient erythema, perhaps of very limited distribution, may be all the symptoms which indicate disease, and examination of the throat may reveal nothing save a little faucial and tonsillar congestion. In a couple of days all symptoms may disappear, and the congestion of the throat may be as short-lived as the general symptoms. In certain of these cases, however, a red tongue with enlargement of the papillæ may give the key to the puzzle, but in others there is nothing for it but to wait for desquamation to confirm a tentative diagnosis of scarlatina. Desquamation is frequently long delayed in mild cases, and shows as nothing more than a fine powder, best seen on the neck, the anterior axillary borders, the shins, and between the fingers

and toes. It may, indeed, be as difficult to pronounce definitely as to the desquamation being scarlatinal as to make a diagnosis during the first days of illness.

Another type of mild case which presents great difficulties in diagnosis is the type where mild throat manifestations are accompanied by no rash, or at any rate have associated with them an eruption so slight and evanescent that when the patient is seen by a physician even on the first and second days of illness it has disappeared, without attracting the attention of those in immediate attendance.

Slight and transient rashes, seldom showing any punctation, are practically impossible to distinguish from a generalised febrile flushing, unless they are much more distinct on the neck and upper part of the chest than elsewhere over the body, or have definitely made their first appearance in these regions before spreading elsewhere, or when, as is least common, the erythema is confined entirely to the neck and upper part of the chest, the back, upper arms and thighs.

Even in the very mild cases when no rash has been observed, slight desquamation may follow some weeks after the onset of the illness, but in a large number of such cases a diagnosis of scarlet fever can be made only on the occurrence of an acute nephritis or some other complication of the disease, or when it is followed by undoubted cases of scarlatina among those who have been closely associated with the patient.

Complications.—In the absence of any certain knowledge of the causal agent of scarlet fever, it is difficult to classify the complications. Some may be due directly to the specific organism, while others are certainly due to a secondary infection by the pyogenic organisms, streptococci, staphylococci and the pneumococcus. It is during the course of the "septic" or "anginous" type of the disease that most of the commoner complications arise, especially those of a suppurative kind, directly due to the sloughing and suppurating throat. Generally speaking, granted that equal care is taken of the patients during the first four or five weeks of the disease, the more severe the case, the more likely is it that complications will occur, but it must be remembered that a

very mild case, if carelessly handled, may develop complications of great gravity, which may result in a fatal termination.

The common complications are *cervical adenitis; rhinitis; otitis media*; *mastoid periostitis*; *abscess in the mastoid bone*; *post-pharyngeal abscess; "collar neck"; suppurative arthritis; periostitis; affections of the heart and pericardium; "scarlatinal rheumatism"; acute nephritis; pleurisy; jaundice*; and *diarrhœa.*

Cervical adenitis in a mild form is extremely common; in fact, some enlargement of glands about the angle of the jaw is the rule rather than the exception in all cases of scarlet fever where there is any marked implication of the throat, but in severe simple and anginous types of the disease the adenitis is sometimes very acute and extensive, affecting the glands in the anterior triangle as well as those at the angle of the jaw. The affected glands are large, painful, tender and matted together, and in bad cases the overlying skin becomes infiltrated and reddened. More or less suppuration of the affected glands is common, and the resulting abscess is often large and associated with considerable sloughing of the skin and soft tissues of the neck. Adenitis appears usually about the third or fourth day of illness, but suppuration is not commonly apparent until some time between the seventh and fourteenth day.

Rhinitis is a frequent and troublesome complication, and is found in severe simple and anginous cases. It appears towards the end of the first week of illness. The nose feels dry and irritable, and very soon swelling of the mucous membrane occurs with resulting mouth-breathing. A thin saniosanguinolent discharge flows from the nose, which excoriates the skin at the edge of the nostrils and also the upper lip. The discharge becomes mucopurulent and scabs form on the nasal mucous membrane which tend to separate when the nose is blown or cleared, and some blood flows after their separation. Sometimes considerable epistaxis results from the rhinitis. Scabbing in the nostrils and an irritating discharge from the nose often persists for weeks, and the condition is extremely liable to relapse and thus prolong convalescence. A scarlatinal rhinitis is often the beginning of a

chronic nasal and post-nasal catarrh with hypertrophy of the turbinates and of the mucous membrane of the naso-pharynx.

Otitis Media is met with not infrequently in cases of the anginous type, and is probably due to a direct infection by way of the eustachian tube. Like the other suppurative complications, it occurs somewhere between the seventh and fourteenth day of illness, and may or may not be associated with much pain. In some cases the escape of a little purulent discharge from the external meatus may be the first indication of any ear infection, while in others the patient may suffer from severe pain in the ear for some days, when no operative interference is made, before the tympanic membrane ruptures and relief comes with the escape of pus. In such cases when there is much pain in the ear, the membrane is seen to be distinctly injected and may bulge outwards.

Mastoid periostitis is met with most commonly in conjunction with some degree of suppuration in the middle ear. There is swelling and redness behind the ear, and it is not uncommon in children for the abscess which usually results from the periosteal inflammation to discharge into the meatus. It is not in itself a serious condition and yields rapidly to surgical treatment.

Abscess in the Mastoid Bone is an exceedingly rare complication of the acute stage of scarlet fever, and is usually found in those patients who have had some previous middle-ear inflammation of a chronic kind.

Post-pharyngeal abscess sometimes arises in connection with an anginous attack and may be attended with grave danger. In all cases where there is any collection of pus in the tonsil or much sloughing of the throat, the posterior pharyngeal wall should be carefully watched for the bulging which is suggestive of the formation of a post-pharyngeal abscess, as, if it is allowed to burst, the patient is exposed to danger from suffocation, septic pneumonia, or a generalised pyæmia from the swelling of the pus. Unless the abscess is drained early, the damage done by its burrowing in the soft tissues may be extensive, and I have seen one case where severe and fatal

hæmorrhage occurred from the ulceration and rupture of an arterial branch.

"*Collar-neck*" is a brawny infiltration of the neck due to a streptococcal infection, similar to the condition known as *angina ludovici* which may arise apart from an attack of scarlet fever. The neck is swelled and reddened, and the swelling is of a very firm consistency. The swelling is suggestive of a thick collar round the neck and may be so extreme that the hollow between the point of the chin and the sternum may be quite lost. The condition is a dangerous one and requires prompt interference. It is, fortunately, a rare complication; it appears towards the end of the first week, usually in association with an anginous attack.

Suppurative arthritis is another dangerous complication, which sometimes makes its appearance during the second or third week of a severe "septic" attack of scarlet fever. The knees and elbows are the joints most frequently attacked, and, in marked distinction from the arthritis of a "rheumatic" type, only one joint is usually affected. The symptoms are pain, not usually severe, swelling, redness and œdema round the affected joint. The swelling is, in the first instance, periarticular. Within twenty-four or thirty-six hours, however, fluid appears in the joint, and great destruction of tissue may result. The fluid is either sero-purulent or frankly purulent in character.

Periostitis or *osteomyelitis* of one or other of the long bones is not very uncommon, and presents the ordinary picture of such acute conditions, save that, as in suppurative arthritis, the condition is attended with much less pain than is usual in a similar condition arising apart from scarlet fever.

Affections of the heart and pericardium are among the most important complications of scarlet fever, although they occur but seldom. *Endocarditis* is the one most frequently met with and implicates the mitral valve with greatest frequency, producing both obstruction and insufficiency, but the aortic valves also may be affected. It has been said that endocarditis always occurs in association with an attack of "scarlatinal rheumatism," but this has certainly not been

my experience. Among the 170 cases of "scarlatinal rheumatism" which I analysed in the *Quarterly Journal of Medicine*, in 1909, only two cases of endocarditis occurred, and this did not by any means represent the total number of cases who suffered from endocarditis among all the admissions of scarlet fever to Belvidere Hospital during the seven years under consideration. It is probable, however, that valvular lesions frequently appear long after the acute stage of scarlet fever is over, so that statistics from fever hospitals throw but little light on the frequency with which endocarditis occurs.

Pericarditis is rarely seen, but when it does appear is almost invariably fatal. It may be accompanied by effusion into the pericardial sac, either serous, sero-purulent or purulent.

Myocarditis is probably a fairly frequent complication of severe attacks of scarlet fever, and is indicated by a weak, rapid and sometimes irregular pulse, and faint ventricular sounds, which may be almost inaudible at the base. It is probable that the extreme tachycardia which sometimes appears about the end of the second and during the third week of the disease is secondary to a myocardial inflammation.

"*Scarlatinal rheumatism*" is the name commonly given to a form of arthritis met with in scarlet fever at various periods of the attack. In the 170 cases which I analysed and to which I have already made reference in connection with the occurrence of endocarditis, the affection occurred during the first fortnight in 125, or 73·5 per cent. of the whole number. More than one joint is attacked as a rule, and it is noticeable that in cases which occur early in the attack of scarlet fever, the wrists and fingers are attacked in greater proportion than other joints, and much more frequently than in the late cases. Early cases tend to be more severe than the late, both as regards duration and acuteness, and appear commonly after a high initial pyrexia, an acutely inflamed throat and early cervical adenitis. In the late cases which I observed, the articular manifestations were on the whole mild, save where they followed on the occurrence of a secondary tonsillitis, and were therefore more comparable with the usual type of early case.

The joint manifestations are largely periarticular, always primarily so, and are rarely associated with much effusion into the joint cavity.

The "rheumatic" arthritis of scarlet fever is extremely painful and, besides the pain in the joints, patients often complain of severe "myalgia."

Scarlatinal rheumatism is often associated with some other complication of the disease, such as cervical adenitis, otitis media or other pyogenic manifestations, but there is no definite relation in point of time between the occurrence of joint pains and other complications; the rheumatic manifestations sometimes precede the occurrence of other complications, sometimes succeed them.

It has been said that the rheumatism of scarlet fever is true acute rheumatism, and its association with endocarditis and chorea has been put forward as an argument in favour of this view. But endocarditis may be the result of many infections other than acute rheumatic fever, and the poison of acute rheumatism is not the only poison which will produce chorea, and I am of opinion that the condition is a "toxic" one, comparable with the arthritis of serum-disease. It may be, of course, that the non-suppurative arthritis of scarlet fever is due to the presence in the joints and periarticular tissues of the specific organism of the disease, but I have failed to isolate any streptococcus from the joints in those cases of scarlatinal rheumatism which I have examined. It is possible, however, that the causal agent of scarlet fever is developmentally higher than the bacteria, and until its discovery it is impossible to be definite on this point.

Painful *nodules* in the scalp, behind the ears and in the muscles sometimes occur in association with arthritis.

Acute nephritis is the most dreaded of the complications of scarlet fever, and occurs in about five per cent. of all cases. It appears usually between the second and fourth week of the disease, during the early part of the period of desquamation, and, while it occurs most commonly as a complication of a severe simple or an anginous attack, it may appear after an attack of scarlet fever so mild as to have escaped detection. Its onset is frequently heralded by a rise in temperature, and

in the majority of cases the temperature is elevated at some time during the first few days of its occurrence. It has been shown that chill is the most active exciting cause of scarlatinal nephritis. The febrile albuminuria which is so commonly present during the first week of the disease must not be confused with the true acute nephritis which occurs, as a rule, after the initial fever has subsided, and after the urine has been free from albumin for some time.

The first sign of the onset of an acute nephritis is usually the appearance of blood and albumin in the urine, associated with headache, nausea, and frequently a rise in temperature. The urinary output is low, and there may even be complete suppression of urine for a time. The patient becomes œdematous, the face being in most cases attacked first. Œdema of the feet, legs and hands is very common, and in some cases a general anasarca may be present. Dropsy of the pleural and peritoneal sacs is sometimes met with.

The amount of blood in the urine is commonly profuse, and it is, on the whole, a favourable sign if the albumin is apparently not much in excess of what might be roughly accounted for by the blood. It is no unfavourable sign to have a profuse hæmaturia early in the attack, indeed, I have frequently found that in cases where the hæmaturia is profuse, the uræmic manifestations are comparatively slight and the duration of the attack is not unduly prolonged. The urine has a sediment which contains blood-casts, epithelial and granular casts and numerous red blood corpuscles.

Headache, nausea, vomiting and even convulsions may occur as uræmic manifestations in the course of an acute scarlatinal nephritis, and such manifestations may be far in excess of any of the indications of acute nephritis found in the urine. Death may occur as the result of uræmia, not usually until the acute nephritis has persisted for about a week, but in one case I have seen death result, after a series of uræmic convulsions, on the first day on which albuminuria was observed, with only the slightest trace of blood in the urine. It is not common, however, for death to occur during the acute stage of the attack; the chief danger of a scarlatinal nephritis lies in

the fact that it may be the starting point of a chronic renal inflammation, producing, as a rule, the large white kidney. The great majority of cases of scarlatinal nephritis, if treated with care and patience, result in cure, and one cannot be too careful in the treatment of all cases which occur, having regard to the future of a patient who does not make a complete recovery from the acute attack.

The acute nephritis of scarlet fever has been said by some to be due to the direct invasion of the kidney by a streptococcus, and they base their inference on the fact that they have discovered streptococci in the urine of patients suffering from acute scarlatinal nephritis. Against this observation may be placed the observations made by Dr. Andrew Love, for long senior assistant physician in Belvidere Hospital, who has permitted me to use his results although they are not yet published. He found that when he took care to sterilise the meatus and used only specimens of urine drawn off by a sterile catheter, he was unable to recover a streptococcus from the urine of patients suffering from acute scarlatinal nephritis, and the natural inference is that other observations when catheter-specimens were not used have been vitiated by contamination from the skin. If this view is adopted, it will be seen that acute nephritis in scarlet fever, like arthritis, may be the result of the action of toxins, and not necessarily due to the direct invasion of the kidney by bacteria, although the possibility of its being due to the invasion of the kidney by a hitherto unrecognised organism, possibly protozoal, must be acknowledged.

Pleurisy is not a common complication of scarlet fever, and may occur at any stage of the attack, from the first week until convalescence is well advanced. In some cases it appears as part of a generalised pyæmia, and in such cases may result in empyema. In most instances, however, it occurs as a simple, dry pleurisy, of short duration, giving rise to no particular anxiety. When pleurisy with effusion occurs, especially during convalescence, the fluid should be carefully examined to exclude the possibility of the pleurisy being of tuberculous origin in a person naturally susceptible to tubercle

whose resistance has been further weakened by the attack of scarlet fever.

Jaundice occasionally occurs during the course of a severe attack of scarlet fever, but is in itself of no particular prognostic significance. It is of the ordinary catarrhal type, and usually yields readily to treatment.

Diarrhœa appears not infrequently as a complication of a severe attack, especially in anginous and semi-malignant cases. It may be very profuse, and if so is of grave import.

Scarlatina may be complicated by other infectious diseases, of which the more common are *diphtheria* and *measles*. It is, perhaps, a rare thing to have the eruption of measles and scarlet fever practically synchronous, but one sees as an occasional rare curiosity the measles rash coming out just as the scarlatinal rash fades and vice versa. It is more common to find that the measles rash appears during the second or third week of scarlet fever, when it is easily recognised by its characteristic appearance and distribution, by antecedent lachrymation and coryza and by concomitant catarrh of the bronchi and lungs.

The detection of a coincident diphtheria is often a matter of great difficulty, and too often it is only recognised by the occurrence of palsy, unexpected cardiac failure, or by the discovery of associated cases of diphtheria. The false membrane is frequently difficult to distinguish clinically from the sloughing throat of a severe scarlatina, and when the slightest suspicion arises in the physician's mind that the throat is at all suggestive of a diphtheritic cross-infection, a careful bacteriological examination should be made.

A *secondary tonsillitis* is sometimes met with in the third or fourth week of illness and even much later. It has much the same character as the primary throat affection of scarlet fever. In a few cases it is accompanied by a typical scarlatiniform rash and may indicate a true second attack of the disease, although the desquamation of the first attack may not be completed.

Sequelæ.—The graver sequelæ of scarlet fever are *chronic otitis media*, *valvular disease of the heart* and *chronic tubular nephritis*, while of the minor sequelæ may be mentioned

chronic nasal and post-nasal catarrh, and a tendency to *chronic inflammation of the tonsils.*

Chronic otitis media sometimes results from the acute otitis media not infrequently met with as a complication, and is dangerous in so far as it may result in a mastoiditis and cerebral abscess.

Valvular disease of the heart is sometimes met with as a sequel to scarlet fever even when no murmur has been apparent during the attack. It is more than possible that this is, in many cases, a pure coincidence, and that the valvular disease is due to a cause quite unconnected with scarlatina, but in some instances the previous history of the patient is so free from taint and his general condition so good, that, in the absence of any local infective focus, the valvular condition must be considered to have had its origin in the attack of scarlet fever. The mitral valve is attacked with greater frequency than any other.

Chronic tubular nephritis is the most dangerous of all the sequelæ of scarlet fever, and is the direct result of the acute nephritis which occurs during the attack. It is, like all forms of chronic nephritis, progressive and quite incurable, and from the nature of the lesion which involves extensively the secreting structures of the kidney, is more rapidly fatal than the primarily interstitial forms of the disease. Œdema of the face and lower extremities is common even at an early stage, and chill, over-fatigue or persistent errors in diet may induce symptoms of uræmia although the condition may have been in existence for only a few months.

Chronic nasal and post-nasal catarrh, and *chronic tonsillitis* are not infrequent sequelæ of scarlet fever where rhinitis has been present during the acute attack or where the inflammatory process in the tonsils has been severe and protracted. Such chronic inflammations are dangerous in so far as the affected tissues are unhealthy and afford harbourage to micro-organisms of all kinds, so that the chronically inflamed mucous membrane of the naso-pharynx or hypertrophied tonsils may form the seat of primary infections which may give rise to multiple arthritis, chronic "rheumatism."

or cervical adenitis both of a simple and of a tuberculous kind.

Diagnosis.—As has already been indicated, the diagnosis of a typical attack of scarlet fever is a matter of ease and simplicity. The sudden onset, high fever, disproportionately rapid pulse, the development of a punctate erythematous rash with a characteristic distribution, the flushed face, injected sclerotics, the circumoral ring of pallor and the typical tongue, with some enlargement of the glands at the angle of the jaw, all go to make up a picture that is impossible to mistake for any other disease. It is where the manifestations are aberrant or very slight that difficulties in diagnosis arise. The rash may be so blotchy as to suggest measles, or may be very slight, presenting no typical punctation, but merely an erythema. The throat may be very slightly injected, so as to suggest only an ordinary faucial catarrh, or it may have an appearance, even at an early stage in the disease, closely resembling diphtheria.

The conditions with which scarlet fever is most likely to be confused are *acute follicular tonsillitis*, the early stages of *quinsy*, *acute ulcerative tonsillitis*, *diphtheria*, *measles*, *German measles*, and certain *septic* and *drug rashes*.

Acute follicular tonsillitis has an onset as sudden as scarlet fever, but there is, on the whole, less headache and nausea, and pains in the limbs are very common. The tongue is coated and the tonsils are enlarged and red. The spots of exudate in the crypts of the tonsils are very characteristic, and there is but little tendency to cervical adenitis. There is no rash beyond, at times, a slight erythema of the chest, arms and back, which presents no punctation. The temperature is high, but the pulse-rate is increased in fairly accurate proportion to the height of the temperature, and is not disproportionately rapid as in scarlet fever.

In the early stages of a *quinsy* the tonsils are swelled, deep red in colour and glazed, as in certain cases of scarlatina anginosa, and the tongue is usually coated with a white fur. The throat is painful, and there is frequently some pain and tenderness in the cervical region with enlargement of glands,

and the patient may be delirious. Otitis media is not an uncommon complication of a quinsy. If, however, a rash is present in connection with quinsy, it is usually of a definitely "septic" kind. urticarial in character, affecting chiefly the elbows and knees. Anything like a general eruption is met with but seldom, and when it does occur it is frankly erythematous, with urticarial patches, and has nothing of the punctate appearance typical of scarlet fever. It may, however, be a difficult matter to make a diagnosis between quinsy with a blotchy erythematous rash and scarlatina anginosa accompanied by a blotchy rash with ill-defined punctation, and it is often necessary to await the development of desquamation before a definite decision can be arrived at.

An *ulcerative tonsillitis*, when one or both tonsils are inflamed and enlarged and show superficial erosions, and when there is a definite enlargement of the cervical glands and an erythematous eruption, may be very difficult to distinguish from scarlet fever. The temperature may be very high, but the pulse rate is lower than in scarlet fever, and the rash when present is usually a blotchy erythema with a sharply defined margin, having the usual distribution of the septic rashes.

Diphtheria may sometimes simulate scarlet fever when it is complicated by a "septic" infection—when the initial fever is high, the face flushed, and the throat presents a generally infiltrated and "dirty" appearance, with no very marked formation of false membrane. Here a bacteriological examination will frequently clear the matter up, and it must be remembered also that it is a very rare occurrence to have a case of diphtheria showing a generalised eruption which is at all like the rash of scarlet fever. Moreover, even in a case of diphtheria which is complicated by an acute streptococcal infection, the pulse-rate is seldom so rapid as to suggest the possibility of scarlatina.

Measles is not often difficult to distinguish from scarlet fever, as the catarrhal symptoms preceding the rash are usually sufficiently pronounced to render the differentiation easy, and the blotchy swollen face and suffused eyes of measles form a picture quite unlike the facies of scarlet fever.

In a few cases, however, a badly developed measles rash may be very like a blotchy scarlatinal eruption, but while it may be difficult to decide from the rash alone which disease is present, a careful study of the throat, and of the history of onset, the behaviour of temperature and pulse, and the presence or absence of the bronchial and pulmonary catarrh which is so common in the early days of measles, will usually serve to place the differential diagnosis beyond doubt.

German measles may simulate very closely a mild attack of scarlet fever, especially that form of it which presents an eruption having the character of a punctate erythema from the coalescence of the discrete spots which commonly constitute the eruption of that disease. In German measles, however, the sore throat is trifling or may be absent, the eyes are often suffused, and the rash usually appears on the face as well as on the trunk and limbs, more after the type of the rash in true measles. The rash of German measles, too, is apt to be fleeting, so that it may appear first on the face and then fade from that region as the trunk is attacked. It tends also to be blotchy on the extremities, although it may be fairly uniform on the body. While enlargement of the cervical glands is common in German measles, such enlargement is not suggestive of an acute inflammatory process as in scarlet fever, but the glands are usually found to be only slightly enlarged and are hard and discrete, while glandular enlargement is found also in the posterior triangle of the neck, the axillæ and groins in a large proportion of cases.

The fever of German measles is usually low and very short-lived and the pulse-rate never approaches in rapidity that commonly met with in scarlet fever.

Septic rashes are occasionally scarlatiniform in character, and are frequently accompanied by fever, but their association with a wound or burn or some other cause of septicæmia and the absence of accompanying sore throat make their differentiation from scarlatina an easy matter in most cases. The distribution of septic rashes is rather in the neighbourhood of joints than on the trunk.

Drug rashes may also be scarlatiniform, and the one which most resembles scarlet fever is that produced by belladonna. The rash is erythematous, and may even be punctate, the throat is dry and injected, the face is flushed, the eyes are bright and the pupils are dilated; there may be some pyrexia, the pulse is very rapid, and delirium is nearly always present. Desquamation follows—usually of a fine powdery kind, but sometimes it has the pin-point character of the typical desquamation of scarlet fever. The fever is very transient, however, and although there may be a little dryness and redness of the throat, there is no tonsillar enlargement, while the tongue is not at all suggestive of scarlatina.

A rash may follow the use of belladonna by the mouth or in a plaster, or even the instillation of atropin into the eye for diagnostic or therapeutic purposes.

The erythemata which occur sometimes after the taking of copaiba, quinine, opium, morphine and chloral hydrate are usually blotchy and show a sharply-defined border against the healthy skin, not at all like the gradual fading off of the scarlatinal rash.

The general symptomatology of scarlet fever is what one must rely on in making a diagnosis. The bacteriology of the disease is still doubtful; although certain members of the streptococcus group and Schulze's micrococcus have been put forward as the causal agent of the disease, it is not wise at present either to deny or definitely affirm that the specific organism has yet been discovered. That many of the conditions met with in scarlet fever are due to the action of streptococci or to certain cocci it would be foolish to deny, but it seems likely that the micro-organism which is the actual cause of the disease still remains hidden from us, either on account of its size or from its general characters, which make it impossible to cultivate or stain by any of the methods which we employ at present.

We cannot, therefore, appeal to the evidence of the microscope or the culture-growth when the clinical evidence is scanty; we must depend entirely on the study of the rash, the general symptomatology, the history and association of the case, and on the occurrence, perhaps, of some of the more

typical complications for our diagnosis, and even the most skilled observers are liable to be at fault in the detection of this most protean disorder, especially in its early stages. It is particularly in the mild cases that difficulties in diagnosis are likely to occur—when the symptoms of invasion are mild, the rash is scanty and atypical, the fever and throat manifestations moderate or almost absent, and the general disturbance slight.

The existence of a pulse-rate which is rapid, out of all proportion to the other manifestations, and the careful study of the time and appearance and the distribution of the rash, the character of the tongue and the punctate injection of the soft palate will help in the formation of a diagnosis, but in many cases one must isolate the patient on suspicion and wait for the occurrence of desquamation before one can say definitely that the disease is scarlet fever. When a patient is seen after the rash has faded, the persistence of papules on the legs and the existence of enlarged papillæ on the tongue are often a help in diagnosis.

The earlier manifestations of scarlet fever are sometimes so slight as to escape notice altogether, and it is only when other cases occur from contact with the patient or he contracts an acute nephritis that scarlet fever is suspected, and after careful examination a little scurfy desquamation on the back, chest and groins and some flaking of the skin between the fingers and between the toes may be discovered and make the diagnosis certain.

In all cases of acute nephritis occurring in children a careful search should be made for desquamation and the history of the case thoroughly gone into, to discover whether or not the nephritis is a complication of a hitherto unrecognised case of scarlet fever.

Treatment.—All patients suffering from scarlet fever must be put to bed and kept there rigidly, for at least three weeks, preferably four. At first the fever, headache and general malaise of the patient make his staying in bed a necessity obvious even to the most careless relatives, but after the fever has declined and the throat manifestations have subsided, the physician may have difficulty in persuading the

patient and his friends that such rigid care is absolutely necessary, and he should bluntly explain the reasons for such care and show how certain complications, avoidable in most cases, are prone to occur after undue fatigue or exposure to surface chill. There is no doubt that the incidence of late arthritis, endocarditis, secondary tonsillitis and acute nephritis is lessened by the strict confinement of the patient to bed and by keeping him warm during the first three or four weeks of illness. This time of rest in bed should not be shortened in a mild or moderate case, but should be prolonged where a case has been of a severe or "anginous" type.

The throat must be kept clean by frequent spraying with a solution of bi-borate or bicarbonate of soda or by sponging it, when the patient is too young to spit, with cottonwool soaked in a similar solution and applied with the finger. The teeth and gums should be cleansed twice or thrice daily with cotton-wool soaked in a solution of glycerine or borax and water.

If there is much sloughing or ulceration of the tonsils, a swab dipped in glycerine of carbolic acid either alone or combined with glycerine of borax should be applied to the part gently but firmly twice or thrice in the twenty-four hours in addition to the spraying and sponging.

When the tonsils are very red and glazed, as in the early stage of certain anginous cases, it is well to be content with spraying and general light sponging, and not to attempt to make strong or firm applications to the tonsils, as they are easily induced to bleed and any rough handling causes the patient a great deal of quite unnecessary suffering.

Headache may be relieved by the application of cloths wrung out of cold or iced water mixed with acetic acid.

The bowels should be freely moved with castor oil at the beginning of the illness, and if diarrhœa is present a small dose of castor oil, combined with a small quantity of laudanum or Battley's solution when the age of the patient permits, may be given daily. Free movement of the bowels about the time of the onset of the fever tends to relieve headache and lessen the general feeling of malaise.

The temperature, if running at all high, may be controlled by tepid sponging, but no antipyretic drugs should be used. Indeed, even sponging has its dangers before the rash is properly developed, as any surface chill is apt to arrest the full development of the rash.

Where the rash comes out slowly and in patches, and tends to be livid and fixed in places, the patient should be sponged or bathed with hot water in which some mustard has been mixed. I have frequently seen patients in the early stages of a severe attack benefit greatly from this simple treatment both as regards the development of the rash and the lessening of delirium, headache, and other symptoms of toxæmia.

When delirium is considerable and is not relieved by cold applications to the forehead or bathing in hot water and mustard it is often associated with great restlessness and obstinate sleeplessness. This happens sometimes in severe "toxic" cases and in the early stages of the anginous type of the disease, and is a very ominous sign. Every effort must be made to induce sleep and many cases have died from neglect of this warning. The best hypnotics to employ are alcohol and chloral; occasional trional and veronal given in combination with alcohol are very effective. The dosage depends on the age of the patient. When chloral is used it should be given in suitable doses repeated every hour until sleep is produced, and it is sometimes a good thing to give a dose of alcohol before beginning the chloral treatment. Alcohol should be given as whisky in hot water with the addition of a little sugar, and for a child of 2-4 years old, ℥i-℥ii repeated in an hour will very often lessen restlessness and induce drowsiness if not sleep. Between the ages of 4 and 6 years, the dose should be doubled, and between 6 and 10 trebled. From 10 to 14 years of age the dose should be from ℥vi ℥iss, while to adolescents and adults ℥i - ℥iiss may be given, and repeated at least once before being abandoned. In some cases it is extraordinary how rapidly the restlessness ceases as the patient comes under the influence of the drug, but in others it may be necessary to proceed with chloral after two or, at most, three doses of whisky have been taken.

In using chloral as an hypnotic in sleepless and restless cases of the graver types of scarlet fever, except when the usual occasional dose is employed, the personal attention of the physician is necessary. The administration of the drug must not be left to the patient's personal attendant, even when this happens to be a nurse of considerable experience, as the treatment is not wholly devoid of risk on account of the large doses which may have to be given. The risk, however, must be run in cases of this type, as unless the patient is made to sleep and to sleep quickly, the case will end fatally, but as such a risk can only be run by a medical man, the physician must take the burden upon himself personally.

The dose of chloral must be regulated according to the age of the patient. For a child of two to four years of age, $2\frac{1}{2}$ grains of the hydrate should be given in a little water, while for an adult a full dose of 30 grains must be used, and intermediate ages should have a dose proportionate to the age. The dose ought to be repeated every hour until drowsiness is produced, taking care that the administration of the drug stops short of poisoning. Careful observations must be taken of the temperature and pulse, as any considerable fall of temperature or weakness of pulse are indications that the drug has been pushed to the verge of toleration, and its use must be discontinued and a rectal injection of hot coffee given to guard against collapse. It is extraordinary, however, how well chloral is borne by those restless cases who present evidence of profound toxæmia, and the fear of chloral on the part of the physician is as dangerous for the patient as the possibility of overdose. The early recognition of the kind of case in which chloral is likely to be of service is often of great importance; it ought always to be used when in severe cases there is much restlessness and vigilant delirium, and should be given as soon as possible after these symptoms have been observed.

If the throat is painful, relief may be obtained by spraying the fauces with a solution of carbolic acid, 1-60, and by applying hot fomentations or tepid compresses to the neck.

In the presuppurative stages of cervical adenitis hot moist dressings of cotton-wool soaked in a solution of carbolic

acid 1-60, are usually sufficient to relieve pain, indeed, in mild cases it is often sufficient to wrap the neck in warm cotton-wool. The glycerine of belladonna applied on a hot compress will frequently bring relief when the carbolic dressings have failed. It is not wise to use linseed poultices, as such applications encourage suppuration which may in many cases be prevented if other methods of treatment are adopted.

On the occurrence of suppuration the abscess must be opened and treated on proper surgical lines.

Rhinitis is best treated by frequent washing out of the nose with a saturated solution of boric acid or a mixture of glycothymolin and distilled water of a strength of 1 to 5. If there is much excoriation of the edge of the nostrils, it may be necessary to apply nitrate of silver or pure carbolic acid to the sores to accelerate their healing.

Otorrhea is best treated by washing out the ear with a saturated solution of boric acid thrice daily, carefully drying the cavity with sterile wool after syringing, and insufflating some powdered boric acid when the cavity is quite dry. Suitable solutions of Izal or Cook's "Co-fectant" are sometimes effective when boric acid fails.

In those cases where there is *pain in the ear* before the occurrence of purulent discharge, the treatment instituted by A. A. Gray is often of service. It consists in introducing a few drops of anilin combined with cocaine and carbolic acid into the ear, and it is extraordinary how frequently this method of treatment will relieve pain and prevent suppuration. In certain cases of severe earache at the beginning of an otitis media when ordinary anodyne applications and "Gray's Mixture" have afforded no relief, it may be necessary to puncture the tympanic membrane to relieve the tension in the ear. The pain of earache is so intolerable that no efforts should be spared for its relief, and a patient should be allowed to suffer as little as possible.

Abscess in the mastoid region demands incision to the bone, and if there is no evidence of disease in the mastoid cells this is all that is required. If, however, there is evidence of disease in the bone, it will be necessary to clear out the antrum and cells, but this operation is very rarely necessary

during the time that a patient is under treatment for scarlet fever, and should, if possible, be delayed until he is free of infection.

A post-pharyngeal abscess must be opened with due precautions as soon as it is diagnosed.

"Collar-neck" and cervical cellulitis also demand surgical interference. In a simple cellulitis it is usually best, before making an incision, to apply large moist dressings of a 1-60 carbolic solution until it is evident at what point sloughing will occur. On the occurrence of a "collar-neck," however, an incision should be made without delay along the line of the sterno-mastoid muscle, as it frequently happens that a little pus will be obtained deep in the neck behind the sternal attachment of the muscle, and in dealing with this condition this region should always be explored and drained. If, as is usual, the condition is due to an infection by a streptococcus which is commonly obtained in pure culture, 20-40 c.c. of a polyvalent antistreptococcal serum should be injected subcutaneously as soon as possible, and 20 c.c. repeated at intervals of twelve hours until three or four doses have been given.

Suppurative arthritis must be treated by free incision as soon as periarticular redness and œdema make their appearance, and in some cases free incisions on either side of the joint seem to prevent the formation of pus in the joint itself. If there be pus in a joint the cavity must be opened and drained.

In scarlatinal arthritis and myalgia, treatment is directed towards the securing of free elimination and the relief of pain. My own experience is that the salicylates internally exercise no specific influence on the pain or the cause of the attack as in acute rheumatic fever, and I have ceased to employ them in this way. I have found, however, that the use of an ointment consisting of methyl salicylate ʒiii and lanolin ʒii applied on lint and covered with guttapercha tissue will often relieve joint pains and myalgia. Sometimes it is sufficient to wrap the joints in cotton-wool, with or without a covering of gutta-percha tissue, and, when other means fail, the application of the glycerine of belladonna ʒi or ʒii on

a hot fomentation, frequently gives relief from pain. After the more acute stage of the arthritis has passed off massage of the affected joint and limbs should be employed.

Elimination should be encouraged by the free use of the citrates of soda and potash and by the employment of mercurial purgatives, calomel, blue pill or gray powder, and the aperient sulphates.

The presence of even a slight arthritis or myalgia is an indication for keeping the patient strictly in bed until the attack has completely passed off. If the patient is thus kept strictly at rest and his eliminative functions stimulated as suggested, the risk of the occurrence of endocarditis and other troubles of "rheumatic" origin will be greatly lessened.

Pleurisy and jaundice are treated on ordinary lines.

Vomiting is best treated by strict dieting and the exhibition of small quantities of iced champagne. When it occurs in profoundly toxic cases rectal or intracellular injections of normal saline solution at a suitable temperature will sometimes control it.

Diarrhœa indicates the necessity for careful diet, and Dover's powder combined with grey powder or calomel will be found to be of service. As in enteric fever, the lower bowel should be irrigated daily with warm water, and the use of a starch or starch and opium enema will frequently bring relief.

Acute nephritis calls for the greatest possible care on the part of the physician. In an ordinary case, where there is no suppression of urine, although the output may be scanty, when there is little anasarca or ascites, and the uræmic symptoms are not urgent, it is sufficient to keep the patient very strictly in bed and free from the risk of surface chill, to insist on his taking a purely fluid dietary in large quantity, and to administer alkaline diuretics in the form of the diuretic salts of potash or "Imperial Drink." It is often a matter of great difficulty to persuade a child to drink sufficiently during an attack of scarlatinal nephritis, and I have found the creation of an artificial thirst by painting the child's mouth and tongue with a saturated solution of sodium chloride to answer very well in some cases.

Suppression of urine may be treated by dry-cupping or wet-cupping over the loins, by bleeding followed by the intravenous or intracellular injection of a pint or more of normal-saline solution, or by hot wet packs.

If uræmic symptoms are present, even if only to the extent of headache and nausea, hot wet packs should be used, and if this is of no avail resort may be had to the steam bath, to wet-cupping over the loins, or to bleeding from a vein followed by saline transfusion.

Free movement of the bowels is an essential part of treatment, and the use of the aperient sulphates in fairly large doses is to be recommended. Not only is it necessary to stimulate peristalsis, but it is wise to use aperients which determine a loss of fluid by the bowel, so that the deficiency in urinary excretion may be thus compensated for to some extent.

After all blood has disappeared from the urine, which may be after a few days or not until some weeks have elapsed, if it be found that albumin continues to be present in the urine for more than a week or so, the use of iron is often found to be followed by good results. Under these circumstances, no better preparation exists than the old-fashioned tincture of the perchloride of iron, which should be given three or four times a day after food, in doses of from 5-15 minims according to the age and tolerance of the patient. Some few patients may show a gastric intolerance of iron in this form, and with these the scale of preparations may be used or a mixture of the perchloride of iron and the liquor of the Acetate of Ammonia, which is a way of giving the fresh acetate of iron combined with a diaphoretic.

Absolute rest in bed until the urine is free from albumin, or until some weeks at least have elapsed after the disappearance of blood is absolutely essential. It must be remembered, however, that in certain cases, where a trace of albumin has persisted in the urine for many weeks in spite of rigid keeping in bed and suitable diet and drug treatment, the albumin disappears after the patient has been allowed up for a few days. If there is much albumin in the urine the patient should not be allowed to get up unless the case has,

in the opinion of the physician, become chronic, and therefore quite incurable. In such cases, reasonable freedom must be given to the patient, or he will soon lose in general condition more than he can gain in respect of the local lesion.

One cannot urge too strongly the necessity for rest and protection from surface chill during the progress of a scarlatinal nephritis, and it is far better to err on the side of over-caution than of rashness in the conduct of such cases. The whole future of a patient may be ruined through the physician yielding to the importunities of ignorant and impatient relatives who resent the prolonged medical attendance and the confinement of the patient to bed who seems fairly well.

When it is remembered that the only way to rest a kidney is to lessen nitrogenous tissue waste, to avoid congestion of the organ, and give a minimum amount of nitrogenous food, the necessity for strict confinement to bed becomes very plain.

Attention to the function of the skin is very necessary, and sponging with hot water in which some mustard has been mixed is very useful. The sponging must be done piecemeal, and the greatest care must be taken during the process to avoid any risk of chill. The bed must be so placed as to be out of any draught, although, as in all cases of fever, the room must be kept fresh and well-ventilated.

The use of digitalis as a diuretic in acute scarlatinal nephritis is not to be recommended, as it tends to aggravate the nausea which is so frequently present. The alkaline diuretics, hot-packing, the application of hot linseed poultices to the loins and the use of the wet or dry cups are infinitely preferable, and much more effective.

Pilocarpine may be used in certain cases where other means fail to induce sweating and increased urination, but the toxic effects of the drug are easily produced, and it is not advisable to push it when the patient is very young or of poor stamina.

Diet.— The diet during the febrile period of scarlatina must be fluid, and should consist mainly of milk, diluted with barley water, plain warm water, or some alkaline aerated water, with the addition of a little citrate of soda, say three

grains to the ounce. The addition of ice to the milk is often very pleasant to the patient, whose mouth is hot and whose throat is painful, and water may be given in small quantities, as often as is asked for. A little chicken tea may be given once or twice in the day, either hot or cold, according to the fancy of the patient.

After the fever has subsided, solids should be added, but only in the shape of carbohydrate foods, so that rusks, toast and bread, with butter, milk puddings, whatever fruit is available, either raw or cooked, rice, potatoes, green vegetables, preparations of oatmeal and maccaroni or spaghetti should form the dietary of the convalescent, besides as much milk as he can take with comfort, for at least ten days after complete defervescence has occurred. Should the patient's appetite demand it, fish may then be added, but it is well to withhold eggs, soup, poultry and butcher-meat until the time has passed during which nephritis usually occurs.

The addition of butter after cooking the rice, potatoes, green vegetables and maccaroni makes them much more palatable.

In acute nephritis the diet should consist entirely of milk, water, and diuretic drinks until at least a week after all blood has been found to be absent from the urine after careful testing and microscopical examination, and the output of urine has risen above the normal. A carbohydrate dietary such as indicated above may be then cautiously instituted, but the amount should at first be very limited. The patient ought to be kept entirely on this carbohydrate diet, which is ample and capable of quite interesting variation, until such time as the albumin has entirely disappeared or the disease is seen to have become definitely chronic.

Epidemiology.— Scarlet fever, like the poor, is always with us, but is liable to great seasonal variations. Epidemic increase usually occurs in the late spring or early summer, and to a lesser degree in autumn. It may be conveyed by direct contact or by infected materials, and it seems likely that the infecting agent of scarlet fever may retain its virulence for a long time outside the body, so that clothes, books, letters, toys and other articles which had been in contact with a

sufferer from scarlet fever and had been put away for months, have, apparently, on being brought out again, given rise to a fresh outbreak of the disorder. It is also capable of being conveyed from one to another through the medium of a third person who is not suffering from the disease, and all persons who are in contact with scarlet fever ought to remember that, without scrupulous care, they may themselves act as foci for the further spread of the infection.

An epidemic of scarlet fever frequently originates in connection with a milk-supply, but it is very doubtful if the disease is conveyed from the cow to the milk. In most cases it is found that a farm-servant or attendant at the dairy has been suffering from a mild and unrecognised form of the disease, and has infected the milk which he or she has handled.

The nasal and buccal discharges are infective from the first moment of onset of the disease, and continue to be so for at least six weeks afterwards. Infection can also be conveyed by the desquamated skin, especially during the early stages of the process of desquamation. It is extremely unlikely that a secondary desquamation is infectious, except in so far as the particles of skin may serve as a resting place and means of conveyance for the infective dust of a ward in which many scarlet fever cases are under treatment.

If there is any excoriation or ulcer on the nasal or buccal mucous membrane, on the tonsil or at the angle of the mouth or edge of the nostril, the nasal and buccal discharges may be virulently infective until these breaches of surface are thoroughly healed, although two or three months may have elapsed since the onset of the fever, and the recognition of this fact is of the greatest importance both in the administration of fever hospitals and in the management of cases at home.

It is the usual custom to isolate all cases of scarlet fever until all traces of primary desquamation are gone, which means for six to eight weeks, but to isolate for longer periods those patients who have any breach of surface on the mucous

membrane of the nose or mouth or on the skin about the nose or mouth, or who have any unhealed wound which has resulted from a "septic" combination of scarlet fever—to isolate such cases, in fact, until mucous membrane and skin are absolutely healthy as far as can be seen after careful observation. There is little doubt that a slight rhinitis with excoriation about the nostrils may be answerable for the infecting of far more cases than an incomplete primary desquamation.

Death-rate.—The death-rate of scarlet fever is at the present day very low. It is probable that in a good class practice it will not often exceed 2 per cent., and even in Hospital the death-rate varies between 2.5 and 6 per cent. The mortality rate is much higher in children between the ages of one and five years than in those who are attacked earlier or later in life. Scarlatina is, indeed, very rare among infants, especially when at the breast.

Second attacks.—These are, considering the yearly incidence of scarlet fever, comparatively uncommon, but they are quite frequently met with. More than two attacks are very rarely seen. The second attack may occur before the patient is thoroughly convalescent from a first attack, or at any time after the first attack has terminated, although it is, perhaps, more common to find that the second attack occurs either within two years of the first, or after many years have elapsed.

Home Prophylaxis.—In every instance where the accommodation is not sufficient to ensure the complete isolation of the patient and his attendant from the life of the household, he should be sent to hospital, as otherwise his family, even though they are not themselves the subjects of scarlet fever, may act as carriers of the contagion from the patient to others.

Where, however, the accommodation of the house permits the reserving of a suite of rooms or entire floor for the use of the patient and his attendant, he may be kept at home, and, if strictly isolated, need not convey the infection to others.

The attendant must have a special overall and dress for use in the sickroom and ought to change her clothes entirely

and take a bath before going out. The sick-room should be stripped of pictures, hangings, stuffed furniture and carpet, and the floor ought to be washed daily with some suitable disinfectant such as "Sanitas" or Cook's "Co-fectant" fluid. Anything which has been in contact with the patient, such as bed-clothes, furniture, or table-utensils, even during the first few hours of illness, must be carefully disinfected before other members of the household are exposed to contact with them. As desquamation commences, it is advisable to rub the skin with a little oil, to prevent as far as possible the dissemination of infective particles of skin throughout the house. All body linen and bed-clothes must be steeped in a solution of carbolic acid, "Co-fectant" or formalin for some hours before being sent to the wash, and all table utensils must be immersed in boiling water before being allowed to leave the sick-room. The urine and stools should be mixed with at least a third of their bulk of "Co-fectant" or crude carbolic preparation before being allowed to pass into the drains.

At the end of the fourth week of the disease or some three weeks after the temperature has finally fallen to normal, the patient should have a hot bath and a thorough scrubbing with soap, every second evening. This process hastens desquamation, and renders the desquamating skin less infective. When nephritis has occurred, the bath should not be given until the urine has been free from albumin for a few days, or until, for the reasons stated above, the patient is allowed to get up even though there is still some albumin in the urine. It is well to arrange, if at all possible, that a patient does not mix with other children for at least a week after he is going about and all infection is supposed to be gone.

Public Health Administration.—On the notification of a case of scarlet fever, the house in which it has occurred ought to be inspected and advice given as to the proper isolation of the patient. When proper isolation is not possible, the case should be removed to hospital at once. At the end of the case or on the removal of the patient to hospital the rooms in which the patient has been at any time during his illness must be thoroughly disinfected. Wallpaper should

be stripped and the walls, floors, ceiling, bed and wood-work washed down with a solution of formalin, and the room thereafter thoroughly aired for some days. Bedding and any clothing or other articles capable of proper disinfection which have been in the room during the patient's illness must be dealt with by steam or formalin, according to their texture. Books and papers used by the patient ought to be destroyed, although it is possible to treat valuable books with formalin vapour, and exposure to fresh air, with a considerable degree of efficiency.

The milk-supply of the household should be strictly investigated and inspection made of all employees engaged either at the farm or milk-shop in case any of them has been suffering from an unrecognised attack of scarlet fever.

When there seems to be any likelihood that an epidemic has arisen in connection with an institution or a school, the inmates, pupils and employees should be carefully examined, and the condition of their health during the previous six or eight weeks investigated, lest any of them may have a mild, unrecognised case of the disease, and may be acting as infective foci for their associates.

The condition of the throat, tongue and skin should be carefully noted, and special enquiries made of the persons under suspicion, parents and associates as to the occurrence of any febrile complaint associated with rash, sore throat or desquamation, and doubtful cases should be isolated for observation.

As in enteric fever, the staff of the health-office should be placed at the disposal of practitioners in the district for consultation in doubtful cases.

Chapter XVI.

MEASLES.

Synonyms.—Morbilli, Rubeola.

French: La Rougeole.

German: Die Masern.

Definition. — An acute infectious specific fever, having a sudden onset, a catarrhal or pre-eruptive stage and a characteristic eruption.

Incubation Period.—The incubation period of measles is much longer than that of scarlet fever, varying, according to different authors, between five and fourteen days. By far the most common period of incubation is between eight and ten days, and the exceptions to this are very few.

Rash.—The rash appears as a general rule between the third and fourth day of illness, but in some cases its appearance is delayed until the fifth day. It first makes its appearance below and behind the ears and on the forehead, particularly at the edge of the hair, and quickly spreads to the face, trunk, arms and legs. It remains bright and distinct for from twenty-four to forty-eight hours and then begins to fade, following the same sequence as on its appearance, so that while it may have practically faded on the face it may still be bright on the legs and thighs. After fading, it almost always leaves a certain amount of brownish-red staining behind it.

The eruption consists of papules, distinctly raised above the level of the skin. These papules tend to occur in crescentic or almost circular groups, surrounding a central area of white skin, but as the eruption develops the concentric areas coalesce in parts, producing large irregular blotches, with "scalloped"

edges. On the face, neck and chest, the crescentic patches may be so closely set as to produce a more or less uniform redness, but the fact that the eruption is definitely raised above the skin serves to distinguish it, in most cases, from the rash of scarlet fever. The fully developed eruption is fixed and does not disappear on pressure.

While the rash on the skin does not appear until the third or fourth day, it is apparent on the soft palate, as a dusky mottling associated with some swelling of the mucous membrane, some twelve to twenty-four hours earlier.

Prodromal Rashes are frequently seen, the more common being a brownish-red subcuticular mottling like a shadow of the true eruption, which may be very apparent on the face, neck and chest, and which precedes the true eruption by about twenty-four hours or even a little longer. Scarlatiniform and urticarial rashes have also been observed.

"*Koplik's Spots,*" called after Koplik, of New York, who first described them fully, are small bluish-white spots surrounded by a red areola, the spot and areola occupying a space not much larger than the head of an ordinary pin. They are found on the buccal mucous membrane, first making their appearance about the level of the first molar tooth. They are few in number in the early hours of their appearance, and may remain few, but in many instances they become very numerous and may be seen not only on the mucous membrane of the cheeks but also on the mucous membrane on the inner side of the lips. As they develop, the distinctive areola is lost and the mucous membrane in this neighbourhood becomes deeply congested. The spots appear, as a rule, with the onset of the first symptoms of measles, and precede the cutaneous eruption by some two or three days. In some cases they appear even before the temperature is raised above normal. They are not found in all cases of measles, but are present in the majority of cases, and, when present, are of the greatest diagnostic value. They are not found on the palate, and fade as the cutaneous eruption appears.

Desquamation of a fine branny kind usually occurs on the face, neck and trunk after the rash has faded, and is sometimes very profuse.

Clinical Types.—The symptoms of onset of measles are those of a severe nasal and pharyngeal catarrh. The patient complains of fulness in the frontal region and frequently suffers from headache. The eyes are suffused and blood-shot and there is acute coryza. A certain amount of photophobia is always present. Cough, of a curious hard dry variety is a usual symptom, and the mouth and throat feel dry and burning. Hoarseness is frequently present, and in some cases the cough has a definitely laryngeal character from the commencement. A few coarse rhonchi are often audible over the chest. The temperature may be little raised, or may be found to be very high from the first onset of symptoms, or may slowly rise as the attack progresses. The catarrhal symptoms persist without any appearance of rash save Koplik's spots or the prodromal mottling described above until the end of the second or third day, when, in addition to the swelled and reddened condition of the fauces, a mottled appearance is apparent on the palate. The cutaneous eruption appears on the third, fourth or fifth day. With the appearance of the rash, the behaviour of the temperature varies in different cases. When the temperature has been high from the beginning of the illness,there is usually a distinct drop, perhaps to normal, just before the eruption begins to appear. When the fever has been slight from the onset there may be no such drop, and in those cases where the temperature has slowly risen from the beginning, no remission occurs before the appearance of the rash.

As the rash appears, the catarrhal symptoms are exaggerated, and, in typical cases, the patient presents a very characteristic appearance. The face is swollen and mottled with the eruption ; there is much photophobia and the eyelids are swelled and reddened ; the eyes are watery and there is distinct evidence of inflammation of the conjunctivæ. Nasal discharge is profuse and watery, the fauces are reddened and swelled and there is some thin exudate present on the tonsils, the pillars of the fauces and posterior pharyngeal wall. The patient coughs and sneezes incessantly and looks utterly miserable. A little bronchial catarrh is the rule at this stage of the illness.

Hoarseness and cough of a laryngeal character may be very marked, and, indeed, the patient may suffer from an acute laryngitis with all the signs of obstruction, and this condition, associated as it is with catarrh of the bronchi, sometimes very considerable, is both troublesome and dangerous. In most cases the catarrhal symptoms subside with the eruption ; the coryza and conjunctivitis disappear, the fauces lose their swollen appearance, and within a day or two of the disappearance of the rash all traces of bronchial catarrh are gone. The nasal and conjunctival discharges often become slightly purulent as the attack passes off, and in the morning the nose is apt to be stopped up with inspissated muco-pus, and the eyelids tend to stick together during sleep. For about a week after the disappearance of the catarrhal symptoms the patient is languid and pale, and during this stage of the disease demands careful attention. Convalescence is usually complete within three weeks from the appearance of the rash in such cases as are only moderately severe and have presented no complications.

Mild types of measles are frequently met with where the initial catarrhal symptoms are quite trifling and may be expressed by a slight nasal catarrh without fever, and in these cases the rash is the first sign which attracts the attention of the patient's attendants. The rash may be limited entirely to the face, neck and chest, and may disappear within twenty-four hours. In such cases there is little aggravation of the catarrhal symptoms with the appearance of the rash, although even in cases so mild as to offer considerable difficulty in diagnosis a little bronchial catarrh is common.

Fulminant cases sometimes occur in which, after a catarrhal stage of unusual severity during which the patient is greatly prostrated, the rash appears but may not develop fully, being evident only in patches on the face, neck and trunk, and having a definitely hæmorrhagic character with abundant petechiæ. In such cases death occurs from simple toxæmia, usually about the second or third day after the appearance of the rash, with hyper-pyrexia, well-marked nervous symptoms and rapid cardiac failure.

In other cases of a somewhat fulminant type, the rash appears normally after a severe catarrhal stage, but retires after some twelve to twenty-four hours. In such cases bronchial catarrh is usually a marked feature of the disease, and as the rash retires a rapidly advancing broncho-pneumonia may develop, or the patient may show signs of cerebral disturbance and die after the occurrence of convulsions and coma.

Cases of an *asthenic type* are sometimes met with, especially in infants, when, after a catarrhal stage which presents no unusual features, the rash develops badly, remaining faint and rather bluish in colour, and, either just before the temperature falls to normal, or shortly afterwards, the pulse becomes rapid and irregular and the patient dies from asthenia and cardiac failure.

Complications.—By far the most common and dangerous complication of measles is *broncho-pneumonia*. It occurs, as a rule, just as the eruption appears, or a little earlier, but is sometimes delayed until about the normal time of defervescence. In some cases the condition in the lung is more of the nature of a *capillary bronchitis* than a true broncho-pneumonia, and on examination of the chest fine moist crepitations are audible over both lungs in front and behind. In such cases the patient suffers from a sensation of suffocation and commonly shows marked cyanosis. Sometimes this capillary bronchitis disappears as the rash fades, but it may persist after the fading of the eruption, indicating a condition of great gravity, and the patient may die with suffocative symptoms and heart failure a few days after the occurrence of the complication, or the condition may persist for weeks and patches of consolidation may appear as the case progresses.

The usual febrile period may be greatly prolonged by the occurrence of broncho-pneumonia or capillary bronchitis, but in many cases the height of the temperature may be quite disproportionate to the gravity of the condition.

Roughly speaking, broncho-pneumonia and capillary bronchitis are dangerous in proportion to the youth of the

patient, by far the greatest number of fatal cases occurring among those who are not yet old enough to spit and blow their noses. Occasionally, however, among adults, broncho-pneumonia may be dangerous to life, especially among those who have recently come to town from the country and have not had a previous attack of measles.

Lobar pneumonia is a rare occurrence, but is sometimes met with, and when it does occur is not uncommonly associated with a pleural effusion which may become purulent. Recovery from such a condition is usual, but convalescence may be greatly protracted.

Laryngitis of a mild type is so common both in the pre-eruptive and eruptive stages of measles as to form one of the symptoms of the disease, but it may sometimes be so severe as to warrant a special mention under the head of "complications."

The laryngitis of the pre-eruptive stage may come on suddenly and give rise to a considerable degree of laryngeal obstruction, while there may be so little catarrh of the nose, eyes, and bronchi, that the true nature of the case may not be at all apparent until the eruption appears.

Again, the laryngitis of the eruptive stage may also be severe and may give rise to such a degree of obstruction that tracheotomy may have to be performed. Its usual association with a considerable amount of bronchial catarrh at this period is an added danger for tracheotomy, which should not be performed except under very special circumstances.

While the laryngitis of the eruptive stage is usually a simple catarrhal condition like that of the pre-eruptive stage, it may be of a definitely "membranous" type, with thick tenacious exudate about the cords, not similar to but closely resembling laryngeal diphtheria. This condition of membranous laryngitis is a very troublesome and dangerous one, and may occur after the rash has disappeared, well into the second week of the disease.

The pre-eruptive laryngitis is rarely dangerous, but that which appears during or after the eruptive period, especially if it has anything of a membranous character, is a condition

of some gravity, and the later it appears in the course of the disease the more dangerous it is.

Cervical adenitis is a fairly frequent complication in association with otitis media, and often goes on to suppuration. It does not, however, occur with anything like the same frequency as in scarlet fever.

Otitis Media is of common occurrence and may give rise to great pain in the ear. In many cases, however, it is comparatively painless, and indeed the first indication of its presence may be a purulent discharge from the meatus. It is frequently accompanied by some degree of cervical adenitis. It is interesting to note that although the otitis media of measles is not usually so acute as that met with in scarlet fever, it is not infrequently followed by permanent damage to hearing, and, it may be, by complete deafness.

Affections of the eye are of common occurrence, and constitute one of the most important groups of the complications of measles.

Some conjunctivitis is almost always present, with a marked degree of photophobia, and in many cases it is very severe, with profuse purulent discharge and much swelling of the eyelids.

Corneal ulcer is not infrequently met with, and constitutes a grave danger to the patient. It is frequently serpiginous in character and associated with hypopyon.

Panophthalmitis sometimes follows on the occurrence of an ulcer of the cornea; indeed, where the infecting organism is the streptococcus, the eye may be totally destroyed within a few hours of the first appearance of the ulcer.

Any of the micro-organisms associated with conjunctivitis and corneal ulcer may be present in the conjunctivitis and corneal ulcer complicating measles, but the most common are the ordinary pyogenic organisms, the streptococci, the staphylococci and the pneumococcus.

It is extraordinary how virulent and severe the affections of the eye may be in measles, and it is well to remember that an attack of conjunctivitis, especially in a child whose previous health has not been good, may speedily lead to complete loss

of sight in at least one eye, possibly in both, and to treat the affection with proportionate care and respect.

The conjunctivitis of measles is highly infectious, and where several children are being nursed in the same room great care must be taken to avoid infecting the eyes of one from those of another, and doctors and nurses attending such cases will do well to take particular care to avoid all risk of infecting their own eyes.

Enteritis may occur during convalescence, and is a troublesome and often dangerous complication. The motions are frequent and consist largely of mucus and blood, with shreds of mucous membrane, and occasionally large mucous casts. This affection is more apt to occur in children who have had broncho-pneumonia and are ill-nourished and feeble, and may persist for weeks until either death occurs or convalescence is slowly established.

Stomatitis is not uncommon and may be ulcerative in character.

Cancrum oris and *noma* are occasionally seen but occur only among children who have been previously ailing and cachectic.

A *purulent vulvitis* and *vaginitis* is not uncommon during the stage of convalescence and desquamation, and is a highly contagious disorder, so that when several girl-children are being nursed together the greatest care must be taken to avoid all risk of infecting one from another.

Among the rare complications of measles may be included *endocarditis* and *pericarditis, tetany, peripheral neuritis* and *disseminated myelitis,* but these conditions are extremely uncommon and merit no more than passing mention.

Nephritis very rarely occurs.

Measles may be complicated by other infectious diseases, such as *scarlet fever* and *diphtheria,* and where such complications occur the outlook for the patient is usually grave. An attack of measles is no good preparation for fighting another infectious fever whose manifestations are in themselves quite serious enough.

Sequelæ.—*Chronic otitis media*, with its well-known attendant ills, may result from an attack of acute middle-ear suppuration occurring during measles.

Opacities of the cornea not infrequently follow on corneal ulcer.

In young children measles, like certain other of the acute fevers, may be the immediately predisposing cause of the occurrence of *acute anterior poliomyelitis*, with resulting atrophy of one or more groups of muscles.

Similarly, it is not unusual to find that *rickets* may follow quickly on an attack of measles.

In both of these conditions, the attack of measles must be looked upon merely as one of the predisposing factors in the causation, and not as the real cause of the disease.

Chronic broncho-pneumonia or *chronic bronchitis* with a tendency to exacerbations sometimes results from the acute bronchitis and broncho-pneumonia of measles, and *emphysema*, *collapse of certain parts of the lung*, the formation of *bronchiectatic cavities* and considerable *cardiac embarrassment* may ensue.

But the sequelæ which are, perhaps, to be most dreaded, are those due to tuberculous infections, to which measles renders children peculiarly liable. It is not uncommon for parents who bring a tuberculous child for examination to state that the child's ill-health dates from a few weeks or months after a severe attack of measles.

Tuberculous meningitis, *broncho-pneumonia*, *pulmonary catarrh*, *adenitis*, and *peritonitis*, may all be included among the sequelæ of measles.

It must be remembered, also, that, short of the occurrence of any definite complication or sequela, it is very common to find that after an attack of measles a child is feeling "below par," both mentally and physically, is pallid, listless and easily fatigued, capricious as to appetite and uncertain as to digestion, and, in short, presents a picture of impaired vitality long after the attack of measles has passed, indicating the necessity for very special watchfulness, lest he should fall a victim, in his vulnerable condition, to some other infection.

Diagnosis.—As there is no micro-organism which is known to be the causal agent of measles, diagnosis must be made entirely from the clinical features of the case—the history, the character of the eruption, the presence of catarrhal symptoms, etc.

The diagnosis of measles in the eruptive stage is not usually difficult. The rash, if well developed, is very typical and the associated nasal, conjunctival and pulmonary catarrh complete a picture that is most commonly unmistakable. The history, too, of a catarrhal stage of some days' duration preceding the eruption is almost pathognomonic. In some cases, however, there is practically no catarrhal stage, and the eruption may be faint and limited in distribution, so that it may be almost impossible to differentiate such an attack of measles from German measles (*q.v.*).

Sometimes the eruption of measles is quite confluent on the face and body, presenting a deep uniform redness, and in such cases it may be difficult to distinguish it from scarlet fever. Its distribution on the face, however, involving as it does the cheeks and circumoral region, which are usually not invaded by the rash of scarlatina, will help to distinguish the two, and it is not common to find so profuse an eruption unassociated with bronchial, naso-pharyngeal and conjunctival catarrh, while, on inquiry, it is usually found that the appearance of the eruption has been preceded by a definite catarrhal stage.

It is, however, in the pre-eruptive catarrhal stage that the diagnosis of measles is difficult and sometimes impossible, while, as the disease is highly infectious at this stage, it is of the utmost importance that it should be recognised as early as possible. A "heavy cold" in a child, accompanied by lachrymation and photophobia, however slight, should always arouse suspicion, especially if any fever is present, and it is fortunate that in the majority of cases, although by no means in all, the presence of "Koplik's spots," described above, will enable a diagnosis to be arrived at some time before the eruption appears. These spots should always be looked for when the symptoms are at all suggestive of the pre-eruptive stage of measles, and if a routine examination of the mouth

were made in all suspicious cases, it is probable that many epidemics would be cut short. It is a very trite remark that when the rash appears the mischief is already done. Unfortunately, the early cases of an epidemic are seldom brought under observation until the rash has appeared, but all contacts with the early cases ought to be subjected to a daily scrutiny and isolated on suspicion when the first signs of nasal catarrh and lachrymation make their appearance, and a careful search for the "spots" made each day, so that a diagnosis may be arrived at as early as possible. Many cases, however, do not show these "spots," and in such cases one must simply isolate on suspicion when the child shows symptoms suggestive of the catarrhal stage and watch carefully for the first appearance of eruption or the prodromal subcuticular mottling which is sometimes present. The association of the case with other definite cases of measles can be sometimes established, and it goes without saying that when measles is known to be rife in a neighbourhood, all cases of "heavy cold" in children are bound to be looked upon as suspect.

Certain *drug-rashes*, notably those produced by copaiba and chloral may closely simulate the eruption of measles, and inquiry ought always to be made with regard to medicines taken recently in investigating a suspicious case.

The eruption of *small-pox* in its papular stage is often extremely like measles, but careful palpation of the papules will reveal the "shotty" base which is so characteristic of variola, and which is not met with in measles.

Treatment.—From the onset of the catarrhal stage the patient should be kept absolutely in bed and particular attention paid to the avoidance of surface chill. It is the habit at present rather to minimise the risk of chill, but there are few people who have had much experience in the management of measles but will admit that chill during the catarrhal and eruptive stages will do much to convert a simple bronchial catarrh into a definite broncho-pneumonia, or induce the development of grave inflammation of the eyes.

At the beginning of the eruptive stage, the development of the rash may be aided as in scarlet fever by sponging with hot water and mustard. If there is much itching of the skin,

sponging with a solution of bicarbonate of soda in hot water or with methylated spirits is frequently of service. A warm solution of carbolic acid (1-60) or the liquor carbonis detergens may be used if these fail to relieve.

The eyes must be washed out several times daily with a soothing antiseptic lotion, by dipping a small piece of cotton wool in the lotion and squeezing the fluid out of it, holding the eyelids apart with the fingers. In hospital, a douche-can with a rubber tube and fine glass nozzle may be used instead of the cotton wool. It is perhaps unnecessary to say that a separate nozzle or a fresh piece of cotton wool should be used for each patient to avoid any risk of spreading infection. After washing, the eyes should be wiped dry with a piece of cotton wool which must immediately be burnt. I have found a saturated solution of boric acid in distilled water, with 1 dram of Battley's solution to the ounce, to be an effective and soothing lotion, and when there is much pain cocain may be added to form a 1 per cent. solution. At night, before the patient goes to sleep, the edges of the eyelids should be painted with an ointment, having lanoline as a base and containing protargol or collargol in a proportion of 5-10 per cent. The protargol or collargol ought to be dissolved in a few minims of distilled water before being added to the lanoline. This practice will lessen the incidence of blepharitis.

If the conjunctivitis be severe, with much swelling of the lids, it is well to drop a little of a 1-1000 solution of adrenalin into the eye before washing with the antiseptic lotion. A 3 per cent. solution of nitrate of silver may also be used to paint the inner surface of the swollen lids, after which the eye should be washed out with a sterile normal salt solution.

When *corneal ulcer* has appeared, the eye should be put under the influence of atropine, and the pupil kept well dilated. If the ulcer tends to spread, especially if no hypopyon is present, the edges should be touched with a galvano-cautery, using a very fine point. The operation is a delicate one and requires some skill, so that, unless the practitioner has had considerable experience in eye-work, it is well to call in the assistance of an ophthalmic surgeon.

If there is *iritis*, pain may be relieved by the application of leeches to the temples, and by the administration of aspirin.

When *panophthalmitis* has supervened, it is, perhaps, the best practice to open the eyeball freely with a knife, thus ensuring proper drainage of the suppurating cavity and lessening the risk of a sympathetic inflammation in the sound eye.

Laryngitis frequently demands special treatment. The patient should be kept in a warm atmosphere made moist by the use of the steam-kettle. An ordinary kettle with a funnel made of brown paper will answer the purpose well where there is difficulty in obtaining a specially constructed article. The use of ipecacuanha wine is to be recommended, as in croup, and special care should be taken to procure an active preparation of the drug, since a perfectly inert preparation is not infrequently sold. The ipecacuanha should be given till vomiting results. Hot poultices or fomentation to the neck are also useful.

Similar treatment should be adopted when the laryngitis appears in the eruptive stage, and, in addition, when there is evidence of considerable bronchial catarrh, poultices to the chest may be employed as will afterwards be described, and one or two minims of the tincture of belladonna may be given every hour in combination with chloroform water.

In the laryngitis which appears late in the eruptive stage or after the rash has faded, the more simple methods described above may be quite inefficacious, and the obstruction to breathing may be so great as to necessitate tracheotomy. This operation should only be performed as a last resort, because experience shows that it is frequently unsuccessful in relieving the condition, which is often associated with a membranous tracheitis and bronchitis, and also not uncommonly with broncho-pneumonia. It is this association, quite as much as the frequently membranous character of the laryngitis itself, that makes the condition so grave and so often fatal.

The *mild bronchial catarrh* so usually met with in measles requires no special treatment, but when a *capillary bronchitis* or *broncho-pneumonia* is discovered the position is different. The fever is often high and may be controlled by tepid or cold spraying and compresses, but in the eruptive stage of

measles it is not advisable to use very cold applications. No antipyretic drug should be given. The headache which accompanies high fever is best treated by cold applications to the forehead, and by the use of sodium bromide in doses suitable to the age of the patient. Hot linseed poultices to the chest, containing a little mustard, often relieve distressed breathing and cyanosis, but should not be allowed to remain on long. The best method is to apply the poultice for some twenty minutes, and have a jacket of Gamgee tissue warmed meanwhile. At the end of twenty minutes the poultice should be removed, the chest rapidly dried with a warm towel and the warm Gamgee jacket put on. Poultices thus used may be repeated every four hours. Poulticing has rather gone out of fashion, and certainly the usual practice of allowing a linseed poultice to remain in contact with the chest for an hour, until it is almost cold, is a ridiculous one, but I have found, especially in young children, that mustard and linseed poultices applied as above described are extremely useful in promoting easy respiration and in lessening cough, both in bronchitis and broncho-pneumonia. Inhalation of oxygen is sometimes of service where there is much cyanosis and cardiac failure.

Dry cupping over the base of the lungs or the epigastrium will sometimes relieve the feeling of suffocation, and venesection has been performed with advantage, when, in connection with the sense of suffocation, there is much cyanosis.

Drug treatment must be suited to the age of the patient. It is useless to give expectorants to children who are too young to expectorate, and it will often be found necessary to give occasional emetic doses of ipecacuanha to children up to four or five years of age, to help them to get rid of bronchial and tracheal mucus. The tincture of belladonna is said by many to be a useful drug in capillary bronchitis and broncho-pneumonia. Its action is supposed to be in the direction of lessening the secretion in the trachea and bronchi, and it also acts as an antispasmodic in reducing paroxysms of coughing. A combination of belladonna with the bromides is a useful general sedative and hypnotic.

In a certain proportion of cases rhonchi and râles and even evidence of patches of consolidation persist in the lungs long after the temperature has come down to normal and acute distress has passed away. When such a chronic condition is established, a different line of treatment must be adopted from that employed during the acuter stages of the complication.

If the weather is warm and sunny, the patient ought to be in the open air as much as possible, preferably lying down. In hospital, the children's beds should be moved out of the ward into the sun for the greater part of the day. Under this method of treatment the resolution of a bronchitis or broncho-pneumonia will often proceed rapidly after hanging fire for weeks. Friction of the chest with the hands night and morning for some twenty minutes at a time, using camphorated oil as a lubricant, also promotes resolution. The iodide of ammonium in small doses and the syrup of the iodide of iron are useful in cases where resolution is slow and they should be used in combination. Where areas of condensation remain in the lung after râles and rhonchi have practically disappeared, breathing exercises may be employed. Post-nasal adenoids and hypertrophied tonsils should be looked for and removed if present.

In all cases where the resolution of a bronchial catarrh or broncho-pneumonia is slow, and especially if the condition is liable to exacerbation, sputum ought to be obtained for examination for the bacillus of tubercle. When the child is too young to expectorate, sufficient sputum may be obtained for staining by introducing a finger into the mouth at the end of a cough and sweeping it round the pharynx.

In spite of all precautions, bronchiectasis may occur and the resulting cavity or cavities may be very offensive. "Open-air" treatment and oil of creosote may be of assistance in the treatment of such cases. The creosote may be given internally or in the form of a dry inhalation combined with the ethereal tincture of iodine, oil of eucalyptus, and spirit of chloroform, in equal parts, 10 drops of the mixture being used in a Squire's oro-nasal inhaler and renewed every hour. The inhaler should be worn constantly except at meal times.

Pleural effusion must be treated on ordinary lines, the

treatment depending largely on the size of the effusion, its duration and its character, whether tuberculous or simple.

Empyema should be dealt with surgically with as little delay as possible.

If *cervical adenitis* is present and suppuration has not occurred, the inflamed gland should be covered with Gamgee tissue and any fricton of the part avoided. After the occurrence of suppuration the abscess must be opened with due antiseptic precautions, and dressed daily with moist carbolic dressings.

The treatment of *otitis media* is similar to that described in the chapter on scarlet fever.

Diarrhœa is often troublesome and necessitates careful feeding. It is sometimes sufficient for treatment to wash out the lower bowel daily with warm water, but in many cases it will be necessary to use small and frequently repeated doses of grey powder with bicarbonate of soda and carbonate of bismuth. Sometimes a little Pulv. Rhei Co. combined with bismuth is very useful. A small dose of castor oil should be given before any other treatment is begun.

In a few cases the stools contain some blood and much mucus, and when this form of dysenteric diarrhœa is present small doses of castor oil may be given daily, and a little Dover's powder should be added to the mixture of grey powder, bicarbonate of soda and bismuth described above.

Stomatitis is often troublesome, and needs very special care, especially in weakly and cachectic children. The mouth should be gently swabbed out every three or four hours with a solution of sodium bi-borate or boroglyceride, especially after feeding. It may be well to intermit milk-feeding for a day or two and feed the child on soups, barley water and albumen water when the stomatitis is at all obstinate.

Cancrum oris is occasionally met with as a sequel of stomatitis when the child is of poor physique and has been, perhaps, weakened by a previous illness. Operative interference is of little service in such conditions, and it is best to keep the affected part as clean as possible, dressing it with a mixture of iodoform and boric acid powder and dry cotton wool or cellulose tissue, until the extent of the slough is

defined. After the extent of the slough is apparent, scraping the part and applying powerful antiseptics has been followed in some cases by healing, but the low resistance of the tissues generally makes such procedure of little avail in most cases. Arsenic and iron may be given, even to very young children, in suitable doses, and a few drams of port wine three or four times a day may encourage appetite, which tends to be poor and capricious, and aid digestion. The condition is a grave one, indicating as it does an extremely low vitality, and in spite of all efforts towards cure, is usually the indication of a fatal termination.

Noma is of less grave significance, and lends itself more readily to surgical interference. The general principles of treatment are similar to those recommended for cancrum oris.

The troublesome complications of *purulent vulvitis* and *vaginitis* which occur not infrequently in children of poor physique in association with a severe attack of measles, are best treated by hot douches of solutions of sodium bi-carbonate, sodium bi-borate or sodium salicylate, repeated several times a day, and followed by the application to the inflamed vulva of an ointment of lanoline, containing some 15 to 20 per cent. of one of the albuminous salts of silver, such as protargol or collargol. Potassium permanganate in fairly strong solution is also of service.

When this condition arises in hospital, or where several female children are being nursed together, the great contagiousness of the affection must be remembered. It is no uncommon thing to have an epidemic of vulvitis in a hospital ward, and when cases occur in a ward the girls should be separated as far as possible from each other by boys. The attendants must be scrupulously careful to avoid all risk of carrying the infection from one to another, and after douching and washing the swabs should be at once burned before the next case is touched. A vulvar pad of cotton wool should be constantly worn by the child to lessen the risk of contamination of the bedclothes.

Rickets following on measles must be treated on the usual lines. The patient should have plenty of fresh air, and if possible sunshine. During the earlier and acuter stages of

the affection, exercise is not advisable, on account of the increase of the deformities which it will induce, but gentle daily massage of the limbs is very beneficial. Milk should enter very largely into the child's dietary, and the food should be light and fresh. No sweet stuff or pastry should be permitted, nor any salted or preserved meat or fish. Butter should be given freely. It is, of course, necessary to prohibit all tea, coffee and cocoa. Of drugs, both iron and the lactophosphate of lime are useful, as is cod liver oil, when it is well borne. If cod liver oil tends to irritation and an unpleasant taste in the mouth for some time afterwards, it should not be used, since pretty much the same effect may be produced by giving plenty of butter and using the lactophosphate of lime. The bowels should be carefully regulated, and small doses of grey powder thrice daily should be given almost as a routine during the early stages of the condition.

Diet.—The diet in measles should be of the ordinary febrile type, and must be regulated according to the condition of the patient.

During the early febrile stage and so long as there is any acute bronchitis or broncho-pneumonia, it should consist entirely of milk and soup, with a little egg flip occasionally. Water may be given freely. As the temperature subsides, a semi-solid dietary should be given, and, a few days later, an ordinary light diet may be resumed, its constituents varying with the patient's age. When diarrhœa or dysenteric diarrhœa are present, pre-digested milk, or at least citrated milk, will be necessary, and no soup save a little chicken tea should be given. In none of the other complications is a special diet necessary, save in the case of rickets. The diet which is advisable in rickets has already been discussed under the heading of "Treatment."

Epidemiology.—Measles is endemic in all Western countries, but is liable to frequent epidemic outbreaks. It is more prevalent, as a general rule, in mid-winter and early summer, than during other seasons of the year. Epidemics usually arise, on an average, about once every two years or so, and in populous districts the disease may assume a very virulent type during these periods of epidemic prevalence. In this

country measles is, on the whole, a disease of childhood, but adults of all ages, especially those who from their early upbringing have not previously had the disease, are liable to fall victims to it during an epidemic. This is particularly apparent in towns whose population is constantly fed by immigrants from the Western Highlands of Scotland, and from the West of Ireland. In isolated communities, such as the islands of the Pacific, the inhabitants are liable to be attacked with equal frequency at all ages when measles is introduced after a long period of freedom from the disease.

The causal agent of measles, whatever it may be, seems to be present in the nasal passages and upper parts of the respiratory tract generally from the first onset of the symptoms, and the disease is highly infectious from the very beginning of the catarrhal stage. It is at this stage that measles is dangerous to a community, on acount of its great infectivity and the difficulty of its recognition. It is probable that the infection is capable, to some extent, of surviving in fomites for some little time, although it is certain that it is much less resistant in this respect than scarlet fever. In any case, measles is a disease which is much more likely to be acquired by direct contact with patients than carried from one to another through the intermediary of a third and perfectly healthy person. "Milk epidemics" are not known. Schools are the most favourable grounds for spreading any epidemic, especially those schools which are attended by the poorer classes of the community, both because the children are under very inadequate observation at home, and also because in such schools the mania for "attendance" is peculiarly rampant.

Period of Infectivity.—A case of measles is infectious from the first onset of the catarrhal symptoms, and must be considered as infectious until at least a fortnight has elapsed after the appearance of the rash, or until all signs of catarrh have disappeared should they persist for a longer period.

Death-rate.—The death rate in measles is very variable in different districts and in different years. It tends to be high during the periods of epidemic prevalence, and is highest between the ages of six months and two years. Over the age of ten years, the mortality is practically *nil*. Between the

years 1885 and 1902, 12,362 cases of measles were admitted to Belvidere Fever Hospital, Glasgow, and the case-mortality over all was 9.1 per cent. Of the 12,362 cases, 1,930 were between the ages of six months and two years, and among these the case-mortality was slightly over 24.75 per cent. When measles attacks a community which has not hitherto suffered from the disease, or in which the disease has not appeared for a very long time, the death-rate is much higher than in an ordinary epidemic, and there is no such difference in the mortality at various ages—the death-rate is much the same in adults as among the children.

In civilised countries the death-rate is notably higher among those of the poorer classes who are insufficiently fed and clothed, and who live under the worst hygienic surroundings as regards dirt and overcrowding.

Second and even third attacks of measles do occur, but are not very common, and the subsequent attacks seldom attain to the severity of the first. It seems probable that many alleged second or third attacks of measles have really been German measles.

Home Prophylaxis.—From the moment that measles is suspected, the patient should be strictly isolated, and put to bed. To wait until the rash has appeared before isolating the patient is quite futile, as the most infectious period of the disease is the early catarrhal stage. Although the infection remains but a short time on any *fomites*, the attendant should wear an overall in the sick-room, as it is quite possible for her to convey infection to others in the same house. All contacts should be carefully watched and isolated on the first suspicion of catarrh. The diagnosis of measles in contacts may be assisted greatly by the discovery of Koplik's spots. At the conclusion of the case, the sick-room requires careful disinfection, and bedclothes and other articles which have been in close contact with the patient must be disinfected by steam or by a solution of formalin according to the material of which they are made. The walls should be exposed to formalin vapour. It is not necessary to be so particular about the repapering and washing of the sick-room as in the case of scarlet fever.

Public Health Administration.—The fact that measles is not a notifiable disease makes it difficult for any medical officer of health to control an epidemic at all adequately, and, although it would be of great advantage to have measles made notifiable, the added expense to the administration of any large district would at first be so enormous as to be practically unjustifiable. But although the death-rate of measles between the ages of 5 and 7 years is only about 4 per cent. on an average, the case-mortality among young children is something over 24 per cent. as we have already seen, and thus, while the death-rate among young children at school is not such as to warrant any great expense on the part of the community, it is evident that a case-mortality of 24 per cent. calls for some interference. One finds that young children, up to 4 or 5 years of age, are in the majority of cases infected by older children who have acquired the disease at school, and this fact makes one think that, short of universal notification, much could be done to lessen the incidence of the disease among young children by an improved system of administration of the disease in our schools. The school medical officer is now an accepted fact, and a system of school notification of cases of measles would enable the authorities to control an outbreak at an earlier stage than is now possible. In this connection, a careful record should be kept of the infectious diseases from which each child has suffered before coming to school and during his school life. When a case of measles has occurred in a class, the class ought to be closed from the ninth to the fourteenth day after the occurrence of the case, permitting members of other classes in the school to go on working unless they happen to be related to the first case. In this way the cases which were infected by the original case would develop at home and would be capable of observation by the staff of the public health department, and the necessity for closing a whole school would at any time be extremely remote. Thus a fairly effective control of the outbreak would be possible with a minimum loss of school time.

When measles occurs in the home of any child attending school, the recommendations of Thomas to the London County Council should be followed:—

(1) That any child who has had measles and is not attending an infant school need not be excluded.

(2) That any child who has not had measles and is attending a school other than an infant school, ought to be excluded until the Monday following the expiration of fourteen days from the occurrence of the case.

(3) That any child attending an infant school, whether he has had measles or not, should be excluded for a similar period.

Such measures taken with regard to schools would obviate to a very great extent the necessity for universal notification, which cannot be urged at the present time on account of the expense involved, not only in payment of notification fees and in increase in the personnel of the public health offices, but also in the increase of hospital accommodation which would at once become necessary. It is quite unfair to tax the already overburdened ratepayer to meet such an increase in expenditure, and yet something more is required than is at present undertaken. A system of school notification and closing, not of schools, but of classes, for the limited time indicated above, would seem to meet the necessity of the case in a fairly satisfactory way, so long as the measures are taken promptly on the appearance of the very first case, and not delayed until secondary cases have made their appearance. Once a crop of secondary cases have appeared, little short of closing a whole school will, in most instances, prevent a spread of the disease which may be very considerable, not only in the school itself, but in the district which it supplies.

The public health department ought to undertake the investigation of all doubtful cases at the request of the practitioner in attendance; should see that isolation is complete; and when complete isolation is impossible, see that the patient is removed to hospital when accommodation is available. The department ought also to undertake at the termination of the case the disinfection of rooms or houses where cases of measles have occurred.

The onus of enforcing the quarantine-time of contacts with regard to school attendance ought to fall on the education authorities.

Chapter XVII.

GERMAN MEASLES.

Synonyms.—Rubella; Epidemic Roseola.
German: Rötheln.
French: Rubéole.

Definition.— A specific and infectious fever, having a short, mild course and a characteristic eruption. The causal agent of the disease has not been discovered.

Incubation Period.— The incubation period of German measles must be calculated as between twelve and twenty-one days, but in considerably more than half the cases it is somewhere between fourteen and eighteen days.

Rash.—The rash of German measles has many points in common both with scarlet fever and measles. It attacks the face first, and appears there as discrete papules, larger than the punctate erythematous spots of scarlet fever, and smaller and less raised than the large papules of measles. Its colour is a red which is not so blue as the eruption of measles, and not so bright red as the rash of scarlatina, resembling rather the colour of a scarlatinal eruption that is just beginning to fade.

As it appears on the face, the circumoral region is always invaded by the rash, a distinction between this rash and that of scarlet fever. The rash on the face is usually composed of fairly discrete papules, but may become blotchy from the coalescence of groups of papules. The blotches are, however, seldom as large as are found in measles. The rash quickly invades the trunk and limbs, and appears there as discrete, rather faded-looking red spots, scarcely raised above skin level. These spots tend to coalesce, and may result in a

generalised erythema closely resembling that of scarlet fever, and, as the eruption tends at the same time to fade on the face, and especially round the mouth, the resemblance to scarlet fever may be very great, especially if, as often happens, the physician has an opportunity of seeing the eruption for the first time only when it is in this stage. In other cases the papules remain fairly discrete, save for some blotches in the bends of the elbows and on the forearms. The appearance of the rash is associated in most cases with some catarrh of the nose and throat and a little injection of the conjunctiva, but even when the rash is profuse there is much less catarrh than in an ordinary case of measles. The fauces and tonsils may be a little injected, and sore throat complained of, but there is no lachrymation and very little coryza.

The temperature is usually raised as the rash appears, but seldom rises above 100° F., although, ocasionally, a fairly high pyrexia is developed on the second day of the rash. The temperature usually falls to normal before the rash fades. Some cases, even with a quite profuse rash, do not show any pyrexia.

The duration of the eruption is very variable. As a rule it persists for some twenty-four to forty-eight hours, but sometimes its duration is only twelve hours, while it may last as long as four or five days. It is not at all uniform in degree all over the body, tending to fade almost completely in parts, and then to become re-intensified. It remains most uniform on those parts which are kept consistently warm, and if it shows signs of fading may often be revived by the application of heat to the skin.

In the majority of cases the rash appears on the second or third day of illness, but is frequently the first sign of the disease that is noticed.

Symptoms of Invasion.—For some twenty-four hours before the appearance of the rash the patient commonly suffers from catarrhal symptoms, which are usually slight. The conjunctiva is injected, giving the "pink-eye" appearance on which so much stress is laid by Clement Dukes, but there is no photophobia or lachrymation. There may be some

sore throat, and the mucous membrane of the mouth, fauces, and pharynx may be slightly reddened. The patient may sneeze occasionally, but there is little, if any, coryza.

One of the most important prodromal signs is enlargement of the cervical and occipital lymphatic glands. This is not constant, but is present in a majority of cases, and is sometimes so marked as to make the patient quite uncomfortable, and the accompanying pain may be considerable.

The prodromal symptoms are usually somewhat exaggerated as the rash appears. In association with the slight catarrh of eyes, nose and throat, the patient may suffer from some general malaise and headache, and shivering or a sensation of chill is common. Vomiting is rare, although some degree of nausea is present in a fair number of adult cases.

While these symptoms of invasion are present in a majority of cases, it is frequently found that the appearance of the rash is the first indication of illness.

In some instances the period of invasion has been observed as lasting for as long as six or seven days before the appearance of the rash, but it is usually of much shorter duration.

Clinical Types.—German measles is somewhat protean as regards the rash, and the constitutional symptoms are, as a rule, so mild as to be almost negligible. A typical case is one in which after a day or two of slight malaise and signs of a little catarrh of the nose and throat, with some pinkness of the conjunctiva, the papular rash appears on the face and the temperature is found to be slightly raised above the normal. In the course of the day the rash spreads to the trunk and limbs, and rapidly becomes scarlatiniform in character on the trunk, while on the limbs it preserves a definitely papular type, with blotches on the forearm and at the bend of the elbow. As the rash becomes fully developed on the trunk and limbs it fades on the face, and, indeed, one of the most characteristic features of this eruption is that it may show great variation in intensity on various parts of the body at the same time. On the same area, too, the rash may fade and revive within an hour or two. The

temperature remains raised for some thirty-six hours, and then falls to normal, and the rash has faded, in most cases, within twenty-four hours. Some degree of desquamation always follows, usually of a fine powdery kind, beginning almost immediately on the disappearance of the rash, and lasting for from two or three days up to a week or ten days. The more profuse the rash, the more definite the desquamation, which, however profuse, never occurs in large flakes as in scarlet fever. In an ordinary case the patient is quite well after the desquamation is complete, but in naturally weak children a certain amount of impaired general health may persist for some weeks.

It is extremely uncommon to find a type of case more severe than is indicated above. Cheadle has described some types of the disease in which severe laryngeal and bronchial symptoms have existed, but these are so unusual in rubella, and so common in measles, that the question arises as to whether the cases described by Cheadle were not really cases of measles, although they had all had measles previously.

In some cases catarrhal symptoms are almost entirely absent, and the only concomitant of the rash may be the "pink-eye" which is so common in German measles.

The character of the rash varies greatly in different epidemics. In one the rash may be very constantly scarlatiniform in character, while in another it assumes the blotchy form, which is difficult to distinguish from true measles.

In the severe cases described by Cheadle the rash was dark purple in colour, and tended to be "fixed," and it is possible that these cases indicated a hæmorrhagic type of rubella. Such severe cases are undoubtedly very rare and on the whole the disease is extremely benign in character.

According to Clement Dukes it is possible to have cases in which the rash is so slight and evanescent as to escape notice, and the manifestations of the disease are confined to a slight amount of "pink-eye" and a little catarrh of the nose and throat.

Complications. — Save in very weak children, accustomed to bronchial catarrh, it is unusual to meet with any

complications in a case of rubella, but in such children bronchial catarrh or laryngitis may occur and even prove fatal.

Sequelæ.—These are also practically unknown in rubella, beyond some impairment of general health for some months, but in children who have suffered from some wasting disease previous to the attack of rubella, the attack appears sometimes to hasten the wasting process, and may accelerate death from asthenia.

Diagnosis. — In an epidemic of rubella there is often much difficulty in recognising the first few cases; later cases present less difficulty on account of association and because of their comparatively long period of incubation, which tends to distinguish them from scarlet fever and measles. But if scarlet fever and measles happen to be epidemic at the time, there is always considerable difficulty in making a diagnosis of rubella.

Apart from the differentiation of rubella from scarlet fever and measles, it is sometimes necessary to distinguish it from *eruptions produced by drugs*, *enemata*, or *errors in diet*. The protean character of such eruptions does not help in their differentiation from rubella, associated as they are with little or no constitutional disturbances, but what is of importance is the fact that in almost all such rashes areas of a definitely urticarial type are present.

The greatest difficulties in diagnosis, however, arise in the differentiation between German measles and *mild cases of scarlet fever and measles.*

In German measles the rash on the body may be strongly suggestive of *scarlet fever*, the temperature may be elevated, there may be little or no nasal catarrh, the fauces and tonsils may be distinctly red, and there may be some mottling of the soft palate. The tongue, however, does not show the enlargement of papillæ which is common even in a mild case of scarlet fever, and there is usually some definite pinkness of the conjunctiva. It is to be remembered, too, that the rash, while definitely scarlatiniform on the body, is likely to show a different character on the leg and the dorsum of the foot, where

it has made its appearance latest. On these areas it usually shows the distinctly papular character above described, the papules being of a faded red colour, and raised only slightly above skin-level. The occurrence of vomiting or definite shivering during the period of invasion would be strongly suggestive of the attack being scarlatina and not German measles, and the presence of albumin in the urine would also point in the same direction, although this sign is so seldom present in mild cases of scarlatina as to be of small practical importance in differentiation.

It may be a matter of considerable difficulty to distinguish a case of German measles from a mild case of *true measles*. The cases of German measles which are most likely to be mistaken for true measles are those in which, when the patient is seen, the rash has not yet disappeared from the face. It is true that as a rule the discrete circular papules of German measles do not tend to run into irregularly shaped blotches, as do the papules in measles, but occasionally the blotchy appearance on the face and arms in German measles is sufficiently marked to render the differentiation from true measles a not altogether easy matter. The colour of the rash, however, in German measles, is much paler and more faded looking than the eruption of true measles, and the papules are not nearly so much elevated above the skin. In German measles, too, there is usually, besides the papular eruption, a certain amount of diffuse erythema in those areas invaded by the rash, which renders the appearance fairly distinctive from true measles, in which the purplish blotches are set in skin that is quite white, and not invaded by a general blush. A measles rash in a very early stage is not unlike the rash of German measles, except that it has no accompanying erythema, but in most cases of measles, even as the rash is coming out, "Koplik's spots" are usually to be found. These spots are never seen in cases of German measles. The appearance of the eyes, too, is very different in the two diseases. While in German measles the conjunctiva is usually very definitely pink, there is no such suffusion of the eyes and lachrymation, with swelling of the lids and photophobia, as may be met with even in a mild case of true

measles where the rise in temperature may be quite trivial. There is a very considerable difference, too, in the severity of the symptoms of invasion. In true measles a well-marked catarrhal period, lasting for several days, is the rule, and a troublesome frequent cough, with sneezing and hoarseness, accompanied by definite coryza, are common in all cases of true measles, however mild. It is true, certainly, that a catarrhal stage of several days may precede the appearance of the rash in German measles, but the symptoms during this period are very slight. Cough is not frequent, sneezing is also infrequent, laryngeal symptoms are even rarer, and the amount of coryza present is very trivial indeed. Another point of importance in a differential diagnosis of the two diseases is that in German measles a history of "stiff neck," associated with some enlargement of the lymphatic glands in the posterior cervical region and occipital region is not at all uncommon. Such a condition may be said to be unknown in measles.

Besides the appearance of "Koplik's spots" in the mouth, it may be said roughly that, while the mucous membrane of the mouth is always inflamed and covered with secretion in measles, this is never the case in German measles, but in both diseases a certain amount of mottling of the palate may be seen, although this is much more common in true measles than in rubella.

In hospital practice, and indeed in private practice of a certain kind, too much stress must not be laid upon the enlargement of glands in the diagnosis of German measles. In children, where little attention has been directed to keeping the head clean, such enlargement is extremely common in association with an irritative and eczematous condition of the scalp, and enlargement of the inguinal and axillary lymphatic glands is also not uncommon in badly kept children.

Treatment.—In a disease which is so simple in its manifestations as German measles, treatment need not be complicated. The patient should be kept in bed for two or three days after the disappearance of the rash, and should be isolated altogether for ten days from the appearance of the

eruption. In hospital, patients may be permitted to go out of doors a couple of days after they have been allowed out of bed.

If there is no fever even during the eruptive stage there is no reason to limit the patient's dietary in any way. If there is fever it is wise to confine the patient to a light diet, not necessarily entirely fluid, until the pyrexia subsides.

In the few cases where bronchitis and laryngitis occur, these conditions may be treated by the application of heat to the neck and chest, by the use of a steam tent, and by Vin. Ipecac. It is very rarely, however, that such conditions arise, and it is seldom necessary even to treat cough.

Epidemiology.—The disease occurs in epidemic form, the commonest seasons for such epidemics being spring and early summer.

It is met with at all ages, and is perhaps more commonly seen among adults than is true measles.

It is highly infectious, but the infection is short-lived, and is generally the result of direct contact with the patient. It is very doubtful if the disease can be carried by a third person, and it is probable that fomites play a very small part in its dissemination. The catarrhal discharges are probably the sources from which the infection is derived.

It is the usual practice to isolate patients suffering from German measles for a period of ten days after the appearance of the rash, but it is quite possible that the patients are not infectious for more than a week.

It is safe to say that, except in those very rare cases where the disease may have taken on a malignant form, recovery always takes place. Sometimes, however, an attack of German measles may hasten death where the patient is already the subject of advanced tuberculosis, or some other wasting disease.

It is possible that *second attacks* do occur, although they are very rare.

Home Prophylaxis.—The patient should be isolated, but no such rigid precautions are necessary on the part of the attendant as in the case of measles and scarlet fever. At the termination of the period of isolation it is

probable that no further means of disinfection is necessary beyond a thorough airing and cleaning of the room in which the patient has been confined. It is well, perhaps, to have all clothing and bedding which has been definitely in contact with the patient disinfected by some suitable means before being washed. The attendant should, of course, be careful to wash the hands and face before leaving the room, and it is well, as a matter of routine, that an overall should be worn in the sick-room.

Public Health Administration. — The local authorities should see that the rooms of patients who have suffered from German measles are properly cleaned and aired after the termination of the case, and they must be prepared to disinfect clothing and bedding, if called upon to do so.

Where the disease breaks out in a school, it is enough to keep such contacts as have not already had the disease away from school from the eighth to the twenty-first day after their exposure to the infection. In addition to this, all contacts should be observed daily with regard to glands and the appearance of any catarrhal symptoms. If this is done, there is very little risk of a second crop of cases appearing. The occurrence of second attacks is so unusual that it is not necessary to quarantine any children who have had the disease before.

Chapter XVIII.

SMALL-POX.

Synonym.—Variola.

German: Die Pocken.

French: La Petite Vérole.

Definition.—An acute infectious disease, characterised by a primary and secondary fever and a specific eruption which passes through the stages of papule, vesicle and pustule.

Incubation.—The period of incubation is most usually twelve days, but it may be as long as fifteen or even twenty days, and as short as eight or nine. Twelve days is, however, by far the commonest incubation time.

Symptoms of Invasion.—The symptoms of invasion are, in the main, those of the onset of any acute fever, namely, headache, nausea, vomiting, frontal headache and general malaise, accompanied or immediately followed by a rise of temperature, both rapid and considerable. But the headache of the early days of small-pox is peculiarly severe. I have heard those who have been accustomed to suffer from severe headache and have also had small-pox, say that all other headaches were slight as compared to that from which they suffered before the eruption of small-pox appeared. Another symptom of invasion in small-pox that is more striking than in the case of other acute fevers is pain in the back. The pain is usually situated in the lumbar region, and is curiously severe and "sickening" in character, and often travels down the legs. It may be associated with definite loss of power in the lower limbs. The symptoms of invasion may be ushered in by a sensation of chill or a definite rigor, or, in the case of children, by a convulsion or series of convulsions. The skin is usually dry and hot, but

profuse sweats may break out from time to time. It is quite impossible to prophesy the severity of an attack of small-pox from the severity and character of the initial symptoms. A severe and ultimately fatal case may be ushered in by comparatively mild symptoms of invasion, while, on the other hand, intolerable headache, violent vomiting and excruciating pain in the lumbar region may precede an attack so mild as to be scarcely recognisable. The pulse during the period of invasion is rapid and full, with no marked dicrotism.

Rash.—The eruption of small-pox appears between the third and fourth day after the onset of the symptoms of invasion. Its appearance is coincident with a fall in temperature and a general amelioration of symptoms. The rash appears first as a series of papules, bright red in colour, and more or less closely set, according to the severity of the case. Even in the severest confluent cases the papules are usually seen to be separate from each other, confluence occurring only as the eruption develops. The papules have a smooth feeling to the touch, and very soon after their appearance it is possible to appreciate by pressure that they have a firm, hard base—this constitutes the "shotty" character of the eruption, which is so often described.

The eruption appears first on the forehead, next on the back of the hands and front of the wrists, and within twenty-four hours appears also on the face, neck and feet, and even, although to a less extent, on the trunk. It may be said that the eruption appears first on those parts of the skin which are most exposed to irritation of any kind, such as exposure to air or chafing from clothing, and it is no uncommon thing to find a closely set group of papules, which may afterwards develop into confluent pustules, although the rash elsewhere is discrete, occupying a position in the lumbar region which marks the point of application of a poultice, fomentation or plaster, which has been used in the hope of relieving the intolerable backache of the period of invasion.

On the fifth or sixth day a vesicle appears on the summit of the papule, and rapidly increases in size, until it is circular, tense, and presents the appearance of umbilication,

having a little depression in its centre. Careful inspection will show that the vesicle is multilocular. It is usual to find a small areola of injected skin round the vesicle as it increases in size, even before suppuration begins. On the eighth day the umbilication disappears, and the vesicle becomes a greyish-yellow pustule, surrounded by a deeply injected areola, and the skin in its neighbourhood becomes swollen. The temperature again rises, and the general symptoms of toxæmia return. The swelling of the skin, particularly of the face, causes a feeling of tension and pain. The eyelids become swollen and are opened with difficulty, and there is a good deal of swelling, accompanied by pain, of the ears, lips, and nose. This is seen even in a discrete case of some severity, and when the elements of the eruption tend to run together—to become confluent—the pain and discomfort are greatly aggravated. In an ordinary discrete case the secondary fever does not last longer, as a rule, than a couple of days or so, at the end of which the pustules begin to shrivel, and the temperature falls. The pustules become dry first on the face, and then elsewhere, following more or less the same order as the appearance of the papules, and by the fourteenth or fifteenth day desquamation may be well advanced on the face.

The distribution of the rash is usually quite typical. The face, wrists, hands, forearms, upper part of the back, and the feet are usually most closely covered by the rash, while as a rule it is scanty on the upper arms, the abdomen, groins, and lower part of the back and legs. The eruption seldom invades the axilla. The mucous membrane of the mouth, pharynx and larynx may be affected, even in ordinary discrete cases, with resulting great discomfort from swelling of these parts.

The mature pustules may rupture and form a fairly large crust, or they may shrivel up, forming a much smaller crust. The crusts on the body separate quickly, as a rule, but on the hands and feet they may linger for many weeks. A characteristic point about the eruption of small-pox is that it appears on the palms of the hands and the soles of the feet, and it is often a matter of great difficulty to get rid of the

remains of the desiccated pustules or "cores" from beneath the hard epidermis of these parts. These "cores" appear as little, dark, hard masses beneath, possibly, quite unbroken skin, and if punctured with a needle they are found to contain a little treacly substance, which is easily removed. The appearance of these "cores" is very characteristic, and they have often been the means whereby it has been definitely established that a patient has been suffering from small-pox when the disease has not been detected in the acute stages.

Prodromal rashes of various kinds have been described as preceding the appearance of the true eruption. They may be either scarlatiniform or morbilliform in character, and while sometimes generalised, they are usually limited to the lower part of the abdomen, the inner part of the thighs, the sides of the chest, and the anterior axillary borders. They may also be found on the extensor surfaces. Prodromal rashes are usually more or less "fixed," and are commonly associated with a dusky erythema. They appear about the second day of illness. The appearance of one at least of these prodromal rashes may be said to be absolutely diagnostic of small-pox, namely, a dusky, brownish erythema with small closely set petechiæ, which forms, when the patient is lying flat on the back with the legs together, a triangle, whose base lies across the lower abdomen at a level with the lower iliac regions, and whose apex is a little way above the knees. This appearance is not likely to be forgotten by any who have had the opportunity of seeing it, and it is met with fairly frequently in an epidemic of any extent. The prevalence of prodromal rashes varies very greatly in different epidemics.

Clinical Types.—Small-pox is usually divided into three classes: (1) *Variola Vera*, which may be either (a) discrete, or (b) confluent; (2) Hæmorrhagic Small-pox; and (3) Varioloid, a modification of true small-pox, which has appeared since the introduction of vaccination.

(1) *Variola Vera* in its *discrete* form has been practically described under the headings of "Symptoms of Invasion" and "Rash."

In the *confluent* form of Variola Vera the eruption tends to appear on the third rather than on the fourth day. The

papules appear in enormous numbers, being especially closely set on the face, neck, wrists, hands and feet, and upper part of the back. It is common for the temperature not to fall to normal as the rash appears, and the general symptoms of fever do not quite disappear. As the eruption matures, the vesicles run together until the whole face, neck, scalp, hands and feet, with perhaps the shoulders and back, are covered with a mass of eruption, which resembles a surface studded with pearls, so closely set that not even a pin could be put between them. The confluent eruption is curiously smooth to the touch. The body is covered with vesicles, in some places quite discrete, while in others confluent patches appear. The scalp, lips, mouth, pharynx, and the mucous membrane of the nose are seen to be studded with vesicles, and the patient suffers grave discomfort from the swelling and pain of the affected parts.

But it is during the suppuration of the vesicles that the patient's discomfort reaches its acme. The temperature rises again to highly febrile registers. Headache, nausea, thirst and sleeplessness are common, and the enormous swelling of the head, neck, hands and feet is associated with great pain. There is usually a considerable amount of cervical adenitis. The eyelids are swollen and œdematous, and cannot be opened; pustules may invade the conjunctiva. The ears are covered with the confluent eruption, and are very painful. To add to the patient's troubles, diarrhœa is common and necessitates frequent handling of the patient by his attendant, a process which is always to be avoided as much as possible on account of the risk of breaking the skin. In no other disease does the patient present such a terrible appearance as in the pustular stage of a confluent attack of small-pox. His head, hands and face are bloated out of all human semblance, he is an offence to eyes and nose, and he lies, delirious or semi-comatose, a mere mass of superficial suppuration. He is an anachronism, a relic of the days when medicine was in its infancy and sanitation non-existent, the victim of the most loathsome plague that ever struck humanity.

In fatal cases, the pulse grows feeble and rapid about

the tenth or eleventh day, subsultus tendinum is present, delirium is marked, diarrhœa may occur, and the patient dies from toxæmia and general asthenia.

When recovery takes place, the patient enters on the stage of desiccation about the twelfth day. The temperature falls, the pustules dry up, forming a scab or "crust," and the subcutaneous œdema subsides. Delirium and sleeplessness are lessened, but the patient is weak, and often shows signs of profound physical exhaustion, and still needs watchful care. The process of "crusting" is usually complete about the fourteenth to the sixteenth day of illness, and, as it is completed, desquamation of the crusts begins, but certain of the crusts may adhere for a long time unless some assistance is given. The crusts tend to persist longest on the hard skin of the palmar surfaces of the hands and fingers and on the soles of the feet. In these situations small "cores" may persist for weeks unless removed by the help of a large needle. These cores show as small, hard, dark brown or black masses buried beneath the skin, and, when punctured, are found to contain a dark treacly substance, which is easily removed by the needle. After the crusts have desquamated, the site which they have occupied is seen to be much reddened and in parts ulcerated, but the patient becomes once more recognisable as a human being. If no complications occur the patient's condition improves rapidly; his appetite is remarkable and his capacity for sleep extraordinary. In confluent cases without complications convalescence is entered upon towards the middle or end of the third week, and a week later the patient, although still unsightly from the scarred and reddened face and scanty hair, may feel well and able to get about.

The *discrete form* of true small-pox differs from the confluent form only in degree. The vesicles run a similar course, are associated with the same inflammatory œdema of the skin, and pass through the same stages of pustulation and desiccation with the formation of "crusts." The temperature and pulse fall with the appearance of the rash, rise again as the eruption becomes pustular and fall as desiccation

progresses. In the uncomplicated discrete variety, convalescence begins about the end of the second week.

(2) *Hæmorrhagic Small-pox* or *Black Small-pox* is, when typical, a form of the disease in which purpuric spots entirely, or almost entirely, replace the ordinary vesicular eruption. The onset is commonly severe, and shortly after the symptoms of invasion have set in, the skin is covered with a dark, erythematous rash. In the course of a day or two hæmorrhages appear in the skin, most marked in the groins, the flanks, the thighs, the bend of the elbow, the axillary margins, the neck and also the face. These hæmorrhages are at first small, but increase rapidly in size and number. The face, where it is not the seat of hæmorrhages, is pale, and the patient has a "large-eyed," anxious look. Fever runs high at the onset, but tends to fall as the eruption appears, and death may occur on the third or fourth day with a temperature of only about 100° F. The pulse becomes rapid, very soft and weak. The patient is painfully conscious of his increasing weakness, but suffers little from anything else save some headache and an intolerable thirst. The mind remains clear, and, indeed, one of the most distressing features of this form of the disease is that the patient may die from asthenia with a mind unclouded up to the last few minutes of life.

Hæmorrhages occur from any surface which is capable of bleeding, from the mouth and nose, from the stomach and intestines, from the kidneys and bladder. The urine is like porter. In women, metrorrhagia always occurs. Subconjunctival hæmorrhages are always present, and the iris is set in a purplish-black surrounding. As the disease progresses not only do the hæmorrhages in the skin increase in size and number, so that the patient's body appears to be splashed with purple paint, especially in the flanks, the neck and the upper part of the chest, but small bruised areas appear apart from the purpuric rash. Death in this form of the disease is invariable, and usually occurs about the third or fourth day, but may be delayed until the fifth or sixth. If life is prolonged beyond the fourth or fifth day, it is common to find a few vesicles appearing irregularly among the patches of petechiæ.

The hæmorrhagic type of small-pox appears with a frequency which varies greatly in different epidemics. Some epidemics, even large ones, show almost no hæmorrhagic cases, while in others the hæmorrhagic type may occur so frequently as to make up some 1 or 2 per cent. of all the cases. The hæmorrhagic type is by no means confined to unvaccinated persons; indeed, it would seem as if this type of the disease appears with almost as great frequency among persons who have had some sort of vaccination in infancy as among those who have never been vaccinated.

Modifications of the typical hæmorrhagic small-pox are frequently met with, when the true eruption precedes or follows immediately on the appearance of the hæmorrhagic rash. In this form the hæmorrhages occupy the bases of the vesicles and the skin between them. The vesicles are badly developed and irregular in distribution. They are flat and empty, and of a bluish colour from the hæmorrhage into their bases. The face is swollen and purple, and the skin of the body generally is cyanosed. The eruption, save only in a few favourable cases, seldom proceeds to pustulation. In such cases the patient's mind is usually clouded, and he suffers from a muttering delirium. Bleeding from the nose and hæmaturia may occur, and subconjunctival hæmorrhages are also frequent.

Death, although the usual, is not the invariable termination of such cases and is longer delayed than in the true "black small-pox," occurring usually at the end of the first week.

Hæmorrhage into the vesicle itself, apart from any other hæmorrhagic eruption, may be seen not infrequently in severe cases of true small-pox, and although this usually indicates a grave condition of the patient, it is not in itself a sign of anything unusual in the case, which proceeds on the normal lines of *variola vera*, and should not be included among the real hæmorrhagic types of the disease.

(3) *Varioloid* is a modification of true small-pox, in which the eruption aborts in the vesicular stage, and does not go on to pustulation.

The symptoms of onset are precisely similar to those met with in true small-pox, and vary as much in intensity. No clue is given as to the future behaviour of the case by either the symptoms of invasion or the early appearance of the rash, which may be scanty or profuse, and preceded or not by the various prodromal eruptions. The initial symptoms may be severe, and the rash profuse, but, after the primary fever has fallen, there is no secondary rise, and the attack terminates with the drying-up of the vesicles, practically none of which develop into pustules. This type of the disease is quite benign.

Complications.—The complications of small-pox are almost all connected with the stage of pustulation, and are chiefly the result of a pyogenic infection of the skin, the eyes, and the mucous membrane of the mouth, throat, and respiratory tract. The more severe the case, the more likely is it that complications will occur.

In confluent or semi-confluent cases, as pustulation passes on to crusting, inflammation of the skin and subcutaneous tissues frequently occurs, and a *cellulitis* may be produced which, although usually limited, may be extensive and severe. At points of pressure *sloughing of the skin and subcutaneous tissues* may occur. This is particularly common over the sacrum and hips, but the skin over the shoulders, elbows, knees and heels may also be affected. Such sloughs are sometimes very deep, so that the upper part of the sacrum may be entirely exposed, or one or other hip-joint may be denuded of the tissues which should cover it, and the capsule of the joint is seen forming the floor of the pressure sore, which is left as the slough separates.

Affections of the eye are frequently met with, the most usual being *conjunctivitis*, *corneal ulcer* and *keratitis*.

The eruption of small-pox is sometimes present on the conjunctiva itself, and a certain amount of *conjunctivitis* is very common, even in comparatively mild cases. It is natural enough, considering the nature of the eruption, that a corneal ulcer should form where the eruption is profuse, and, while in most cases it is tractable and heals reasonably well, in some cases it spreads with great rapidity and

may produce a *panophthalmitis* with complete destruction of the eye. Blindness may also result from *keratitis*, when, as sometimes happens, the whole cornea is involved. In many cases, however, the keratitis is limited, and the opacity clears up gradually, but sometimes a limited keratitis may result in the formation of a deep perforating ulcer. If the ulcer is not very large, the opacity which results from its healing may disappear, but it is more often permanent. Keratitis is usually accompanied by photophobia, and increased intra-ocular tension. The inflammation commonly begins at the outer margin, and is very frequently limited to about a half of the cornea. Only one eye may be affected, and where both eyes are attacked, one is usually much more severely affected than the other. A particularly destructive form of keratitis is that which is sometimes met with in severe confluent cases, in which there is no photophobia or injection of the conjunctiva. The cornea is seen to be dull, quickly becomes cloudy, and the whole cornea may become opaque in twenty-four hours. In the course of a day or two it sloughs, the aqueous humour is discharged, the iris prolapses, and the lens protrudes. A complete anterior staphyloma may be the result, or even a panophthalmitis. In some cases only part of the cornea sloughs, and, if the perforation is small, only a small staphyloma may occur.

Glossitis is sometimes met with, and *sloughing of the fauces and soft palate* may result in the formation of deep and extensive ulcers, which are often very foul.

Of all the complications of small-pox the most fatal are those which are connected with the *respiratory tract*. In severe cases the eruption spreads even to the finer bronchi, so that on examination of the lung *post mortem* it is quite recognisable, and a *septic bronchitis* or *broncho-pneumonia* is of frequent occurrence in confluent cases. *Lobar pneumonia* is much less frequent, but is also met with; *pleurisy*, either dry or with effusion, is rare. Where an effusion occurs it is usually purulent.

Slight *laryngitis*, as shown by some degree of hoarseness, is a very common complication, and if it remains slight has no serious significance. If, however, it is severe enough to

cause complete aphonia, or if there is definite dyspnœa, the outlook is extremely grave. Acute *œdema of the glottis* may occur, and there may be more or less extensive ulceration of the laryngeal cartilages.

Orchitis is not infrequent, and *adenitis*, especially of the cervical and axillary glands, is fairly common, usually going on to suppuration.

The *complications connected with the nervous system* are not very numerous. *Delirium*, which is common in the early febrile stages, occasionally takes on an acute *maniacal* type, and a few cases have been recorded in which this has persisted for some weeks. *Peripheral neuritis* is uncommon. *Paraplegia* sometimes occurs, and this is frequently a very unfavourable indication. Some degree of loss of power of the legs, however, is not very rare, in association with the severe lumbar pain which is so usual as one of the symptoms of invasion. This does not seem to be due to a peripheral neuritis, but is more likely due to an affection of the spinal cord or meninges, presumably of toxic origin. The condition is one of no particular gravity, and, although unusual weakness of the legs is apparent during convalescence, with some exaggeration of the knee-reflexes, recovery takes place rapidly. *Hemiplegia* has also been observed, but possibly only as an accidental and intercurrent affection.

When small-pox is complicated by *pregnancy*, abortion occurs with a frequency which varies largely with the age of the fœtus and the severity of the attack; *i.e.*, the older the fœtus and the more severe the attack, the greater is the chance of abortion. It occurs in all hæmorrhagic cases who survive beyond the third or fourth day, and in many at an earlier period. In severe confluent cases, also, abortion always occurs, usually during the vesicular stage of the eruption. In less severe cases, if abortion occurs it does so most commonly in the second or third week of the disease, and may be delayed even until the patient is convalescent. Severe hæmorrhage is frequent, and there is often trouble with the placenta. Abortion is fatal in all hæmorrhagic, and in most confluent, cases. In discrete and varioloid cases the outlook for the mother is good.

The fœtus may be born with the eruption, or may develop the disease shortly after birth, having been infected *in utero*. Sometimes it is born without having contracted the disease, and may be rather refractory to vaccination.

Sequelæ.—In severe cases, where there has been much destruction of the skin during the stage of pustulation and crusting, *pitting* is the result, and in severe confluent cases the scarring may be so considerable as to distort the eyelids, the mouth or the nose. The scars are at first deeply pigmented, but they ultimately become white.

Blindness may result from keratitis with extensive sloughing.

In a case in which the eruption has been profuse in the scalp, patches of *baldness* are frequently left, which, however, persist only for a short time unless there has been very unusual destruction of the scalp, in which case some patches may be permanent.

Diagnosis.—A case of small-pox may present itself for diagnosis in one of three stages—in the stage of invasion, in the stage of eruption, and in the stage of desquamation when all signs of eruption have disappeared except pigmentation, scarring, and the small buried cores.

Diagnosis in the stage of invasion: It is only during an epidemic of small-pox that there is the slightest chance of diagnosing a case at this period of the disease. The symptoms of invasion differ so little from the symptoms of invasion of any other acute fever, that it is a matter of extreme doubt as to whether any case could be diagnosed as small-pox at this time, save in association with other cases which are manifestly variola. It is true that the headache is more intense, and that the backache is as a rule of far greater severity in the prodromal stage of small-pox than in any other acute fever, but one cannot establish a diagnosis on this alone. It is only where the prodromal rash of a petechial character, limited to the lower abdomen and inner side of the thighs, occurs, that one can arrive at a diagnosis of small-pox before the true eruption has made an appearance. This prodromal rash, however, is so characteristic of the disease, that in the absence of any other definite sign of

small-pox, apart from the symptoms of invasion, it may be taken as absolutely diagnostic. It is not at all infrequently seen in the course of an epidemic, or even at the beginning of an epidemic, and it is of the greatest importance that physicians should be familiar with this, as one never knows whether the recognition of a case of small-pox in an early stage may not be the means of limiting an epidemic, which might otherwise reach vast proportions.

Diagnosis in the stage of eruption: The eruption of small-pox, especially if it be at all scanty, may be confused in the papular stage with measles and certain drug rashes, or even with syphilis, while in the vesicular stage it may bear a striking resemblance to the eruption of chicken-pox, and also to certain types of pemphigus, especially the syphilitic variety of that eruption.

In the papular stage, the eruption of small-pox makes its first appearance on the forehead, spreading to the face, neck, scalp, hands and feet. The papules are definitely slightly raised above the skin, and have a more velvety feeling to the touch than the ordinary eruption of measles. The absence of coryza and lachrymation serve to differentiate it from the early eruption of measles, and there is no tendency in small-pox for the papules to run together in crescentic groups. But the most notable feature of the papular stage of the eruption of variola is the distinct hardness of the base of the papule, which is usually so marked as to give the examining fingers the feeling as if small shot were embedded in the skin. This condition is rare in measles, and even when present is much less marked than in small-pox. The same characters tend to differentiate the small-pox eruption from any *drug rash*. The drug rash which is most usually brought up for differential diagnosis during an epidemic of small-pox is a rash produced by the taking of copaiba, and a careful enquiry into the history of the case will usually serve to bring out the fact that the drug is being taken, and also the reason for its administration.

One must remember, however, in spite of the definite statements made with regard to the "'shotty" character of the rash in small-pox and the soft character of the papule in

measles, that in certain cases of small-pox there may be a total absence of the "shotty" feeling, and in some cases of measles the papules on the forehead may be unusually hard, so that a differential diagnosis may be a matter of extreme difficulty. Where there is any doubt whatever in the mind of the physician the case must be isolated, and observed with care, until such time as the appearance or non-appearance of the vesicular eruption places the matter beyond doubt. In such cases the patient should be vaccinated on three successive days, and successful vaccination will prove that the case is not small-pox.

Diagnosis in the vesicular stage: It is not likely that a typical confluent or semi-confluent eruption of small-pox will be mistaken for anything else, but where the eruption is scanty, and where there is no definite association known with any other case of small-pox, a rather scanty small-pox rash in the vesicular stage may be easily mistaken by the inexperienced for a moderate eruption of chicken-pox. There are certain definite characters, however, presented by the small-pox vesicle which are not presented by the vesicle of chicken-pox. The small-pox vesicle is circular, shows evidence of loculation, and shows a small depression on its surface or umbilication. The loculation of the vesicle makes it very firm and resistant to pressure, so that it does not burst when pressed on by the finger with anything like the same ease as the flabbier unilocular vesicle of chicken-pox, which, too, has no umbilication on its surface, no hard base, and very little areola. The distribution, also, of the rash of small-pox serves to distinguish it very largely from that of chicken-pox. Even in an attack of chicken-pox with profuse eruption it is very rare indeed to find any vesicles on the palms of the hands or on the soles of the feet, whereas even in a case of small-pox with a rather scanty eruption vesicles are usually found in these situations, although not always. It is to be remembered, however, that the vesicle of chicken-pox is sometimes found on the palms of the hands and on the soles of the feet, and, where this is so, the general character and distribution of the eruption must be considered with a view to the differentiation of the disease.

The eruption of small-pox always follows on a definite period of invasion, whereas the eruption of chicken-pox is usually the first sign of the disease. The eruption of small-pox follows a more or less regular sequence in appearance, and the rash in definite areas is usually at the same stage, *i.e.*, while it may be papular on the back and vesicular on the face, you do not find in the same area late vesicles and early papules together. In chicken-pox, however, one finds on a few square inches of skin, say on the back, papules, vesicles, crusts, and scars together, indicating the fact that the eruption has come out in successive crops. The vesicle of chicken-pox, also, tends to be rather oval than round; the crust and the scar preserve the same formation. Sometimes the vesicles of chicken-pox are small, hard and resistant to pressure, but as a rule a varicellar eruption with these characters is only found on the forearms, the leg from the knee downwards, the hands, and the feet, and if the whole body be inspected when such an appearance is found in these regions, typical vesicles of chicken-pox will usually be apparent elsewhere on the body.

The eruption of chicken-pox appears first on the trunk, and is most profuse in that region, while the small-pox rash appears first on the forehead, wrists, hands, face, legs and feet, and is always more profuse in these regions, while it is scanty on the trunk, where it appears last.

Atypical forms of the chicken-pox eruption are more commonly met with in adults than in children, and it is in such cases that any real difficulty in the differentiation between small-pox and chicken-pox will arise. In differentiating small-pox from chicken-pox, one is naturally influenced to some considerable degree by the date and degree of vaccination. If a doubtful eruption appears in childhood, say before the age of seven or eight and the child has been vaccinated, even inefficiently, the chances are largely in favour of the eruption being chicken-pox, and not small-pox. If in an adult there is evidence of good infantile vaccination, and the patient has, in addition, been successfully re-vaccinated, the evidence is similarly in favour of its being chicken-pox. If, however, the eruption appears in a child,

even as young as from seven to ten years of age, who shows evidence of only very slight and inefficient vaccination, it is to be remembered that the eruption may be small-pox. Still greater is the possibility of the disease being small-pox if the eruption appears in an adult who has only been vaccinated in infancy, especially if the vaccination has evidently been slight.

Other vesicular eruptions which may be mistaken for small-pox are *pemphigus* with a profuse eruption, where the bullæ are small, and a vesicular syphilide. In these cases the eruption should present no difficulty to the experienced physician.

In *true pemphigus*, even where the bullæ are small and very numerous, they are so much larger and so much more flaccid even than the vesicle of chicken-pox that they are little likely to be mistaken for the small, compact and firm vesicle of variola.

A *vesicular syphilide*, however, may show small, closely-set, firmish vesicles, with a distribution on the face and forearms, that may be very like the eruption of true small-pox. It is to be remarked, however, that the rash, which may be profuse in certain areas, like those mentioned above, is irregular and patchy in distribution, while in a case of true small-pox the vesicles may be scanty, but they are distributed with some regard to the usual distribution of the rash, and they are rarely very profuse in one region, while entirely absent in another. In the case of a vesicular syphilide the forearms may be closely studded with an eruption that is almost confluent, while large areas of the trunk, limbs and face may be entirely free from eruption. The irregular character of this eruption, combined with the history of previous venereal infection or the evidence of some genital sore, usually places the diagnosis beyond question. In certain cases, however, the test of vaccination must be applied before one is certain of the true nature of the disease.

It is not uncommon during a small-pox epidemic for the physician to be asked to see cases which are suspected of being small-pox, in which there is a definite pustular eruption, most profuse, perhaps, upon the forehead, the face

generally, and the neck, which presents certain of the features of the eruption of small-pox. Upon close examination, however, these pustules are found to be very much more raised than the ordinary pustule of small-pox. There is little swelling of the surrounding parts, although the base of the pustule may be deeply reddened, and even the closest questioning fails to educe the history of a definite period of invasion, and the patient cannot be definite that the eruption has ever passed through a vesicular stage. These pustular eruptions are due to *acne*, or may be forms of *rash following on the taking of the bromides or iodide of potassium*. If the patient is found to have been taking bromides or iodide of potassium, the case is clear, and the presence of blackheads and old scars will be sufficient to establish the diagnosis of acne.

Treatment.—All patients suffering from small-pox must be kept in bed during the febrile stages of the disease. *During the papular stage* of the eruption pain and irritation may be relieved by sponging with tepid water or a tepid solution of 2 per cent. carbolic acid. Ichthyol, applied to the face or to any other part where the eruption is profuse, appears to relieve pain in a certain number of cases. Oil, either plain olive oil, carron oil, or carbolised olive oil, is also used as an application to relieve the discomfort and irritation during this stage of the eruption. During the vesicular and pustular stages, ichthyol or oil may be applied to the skin, but oily applications are often prone to cause irritation, and antiseptic powders, such as boric acid, either alone or with starch, are possibly better, although they have the disadvantage of making the crust firmer and less easy to detach from the skin, thus rather favouring ulceration. A salicylic cream makes a pleasant dressing in the vesicular and pustular stages of the disease, the ingredients being 4 parts of sodium salicylate to 100 parts of ordinary cold cream. Should the skin be broken in the vesicular and pustular stages, it will be found necessary to dress the parts with a simple moist antiseptic dressing. If the eruption promises to be profuse on the scalp, the hair should be cut as close as possible. This makes it easier to deal with the eruption in the pustular and crusting stages.

In confluent and semi-confluent cases, particularly where the patient is delirious, it is necessary to muffle his hands in cotton wool to prevent him, as far as possible, from breaking the vesicles or pustules, thus avoiding the formation of large raw areas.

The handling of a small-pox patient is a difficult matter. Even with the greatest care the epidermis is apt to be torn, especially if the patient is delirious and struggles.

It is of the utmost importance that a patient who is suffering from a severe attack should be made to *sleep*, and the safest hypnotic to use in small-pox is undoubtedly opium. Chloral and the coal-tar derivatives have a disagreeably depressing effect upon the heart, and as cardiac failure is the chief danger in small-pox they are better avoided. Perhaps the best form of opium to use is the *liquor opii sedativus* of Battley. This should be given in 15 or 20 minim doses, and repeated every hour until sleep is obtained, or 60 to 90 minims have been given. This dosage may seem excessive, but the small-pox patient is curiously tolerant of the drug, and where the administration is confined within these limits there is little fear of any bad result. Alcohol, in the form of whisky or brandy, in doses of ℥ ii.—℥ iv., may be combined with the opium with advantage. For obvious reasons, save in cases in which the eruption is discrete, the use of the hypodermic syringe is not to be advised.

As in all other acute fevers, it is not in general a good practice to reduce the pyrexia by means of antipyretic drugs on account of the danger of cardiac failure, which is always present after their use. The one exception, perhaps, to this rule is quinine, which is sometimes of service in 5 or 10 gr. doses in lowering temperature and lessening headache.

In the early stages of the eruption sponging with tepid water may reduce the temperature sufficiently to bring relief to the patient's symptoms. The cold pack is not to be recommended.

If there is much vomiting during the initial stages, a little morphine will usually stop it.

Constipation may be relieved by small doses of calomel followed by mild saline aperients, or cascara sagrada may be

given, or, indeed, any aperient that is pleasant in action, and not too severe.

If much diarrhœa is present, Dover's powder and calomel should be given, and the lower bowel washed out carefully with sterilised water once or twice a day.

Where there is some degree of cardiac failure, alcohol in the form of whisky or brandy may be given, in doses of ℥ii.—℥iv., to be repeated every two to four hours. Strychnine is sometimes useful, and where the heart's action is rapid and irregular the tincture of digitalis may be given with advantage, in doses of 10 minims every four hours while the patient is awake. Adrenalin has been found useful by many physicians where the blood pressure is very low and there is a threatening of collapse. Ammonium carbonate is a good diffusable stimulant where there is any sign of cardiac weakness, even where there is no bronchial catarrh. If bronchial catarrh be present, the ammonium carbonate may be combined with some spirits of chloroform and camphor water.

In hæmorrhagic small-pox, where there is much bleeding from the mucous surfaces, adrenalin and ergotin have been used, but most observers are agreed that their employment has been followed by no good result.

It is of the greatest importance that the mouth should be kept clean, and it must be swabbed out several times a day with glycerine of borax or glycerine and boric acid. If the mouth is very foul it is wise to spray it, as in scarlet fever and diphtheria, with an aqueous solution of boric acid or sodium bi-carbonate. If the patient is conscious he may be able to wash his mouth with glycothymolin, of a strength of 1 part of glycothymolin to 5 of water.

Sometimes swallowing is painful and difficult, and small pieces of ice sucked slowly will help to relieve this. Where the difficulty of swallowing is extreme, painting the fauces with a dilute solution of cocaine before feeding has been recommended.

As soon as the crusts have formed it is well to hasten their removal by the application of warm poultices of linseed meal and oil in all cases where the eruption has been at all profuse. This application may be made even to the face,

when the poultice should take the form of a mask, with apertures left for the eyes, nose and mouth. After the crusts have separated, the skin should be frequently washed with dilute solutions of boric acid, as it is of great importance that suppuration should cease as soon as possible.

From the beginning of the illness the patient's *eyes* should receive careful attention. Vaseline, or better still, an ointment composed of 4 or 5 per cent. protargol, or some similar salt of silver, in lanoline, should be smeared on the edges of the eyelids at night, to prevent the lids sticking together. The eyes should be washed frequently during the day with a solution of boric acid or bi-carbonate of soda. If there is much swelling of the eyelids and inflammatory œdema of their mucous membrane, the mucous membrane may be painted several times in the day with a 10 per cent. solution of silver nitrate, which should be immediately neutralised with salt solution. If keratitis occur the pupils should be widely dilated with atropin, and the eyes should be very frequently irrigated with warm boric acid solution or even sterile water. If the intra-ocular tension is decidedly raised, it is well to perform paracentesis, which may be repeated more than once should occasion arise. The addition of opium to the eye-wash in the form of the *liquor opii sedativus* is often of great comfort to the patient. In cases of keratitis where there is little sign of conjunctival reaction warm fomentations should be applied over the eyes, and renewed every hour or two. Should panophthalmitis occur, it is well to lay the eyeball open from side to side, and let the discharge escape freely. Small ulcers of the cornea will probably yield to a yellow oxide of mercury ointment, combined with a little atropin, a small quantity of which may be inserted under the eyelid twice a day. If the corneal ulcer tends to perforate, its edges may be cauterized with a fine wire.

All superficial *abscesses* should be opened at once on their formation, and dressed with ordinary warm moist antiseptic dressings.

Laryngitis, when it does occur, demands very careful treatment. On the first appearance of this complication, however slight, it is well to put the patient at once on Vin.

Ipecac., and use the steam tent. A medicated steam spray is also of service, and should be charged with either a simple soda solution or a dilute solution of carbolic acid. If *œdema of the larynx* should occur, it may be necessary to perform *tracheotomy*. As this complication appears usually in confluent cases the operation of tracheotomy may be attended with much difficulty, on account of the swelling of the neck, and profuse hæmorrhage from the infiltrated cellular tissue may result.

Glossitis, if it be slight, does not demand any particular interference, beyond the application of ice to the tongue. But in certain cases the swelling of the tongue may be very considerable, and may require incision. The incision should be made about three-quarters of an inch to the side of the raphe, and should be about half an inch in depth; if made at all, the incision should be free.

Cellulitis may occur almost anywhere in association with profuse pustulation, and demands free incision and frequently repeated warm, moist, antiseptic dressings.

Many artifices have been recommended for the *prevention* or *modification of pustulation*, but all applications having this object in view are practically useless. The red light treatment introduced by Finsen was also advocated for this purpose, but Finsen's good results have not been obtained by others who have employed the treatment in this country. The development of the eruption does not appear to be altered in any way, the pitting does not seem to be lessened, and patients confined in a room which is lit only by the red rays, and from which all actinic rays are excluded, seem to suffer psychically from this deprivation, and become restless and discontented, and the tendency to delirium seems to be increased.

Serum therapy has been employed in this country by Thomson and Brownlee, with little result. The serum used was obtained from immunised calves or heifers, and one notable disadvantage of this treatment is the enormous quantity of serum required. It is reckoned that the amount of serum necessary amounts to about one-fiftieth part of the body weight in adults, and to about one twentieth part of the body

weight in children. It is said that this enormous quantity of serum produces no ill-effects, but I recollect at least one case in which it seemed that death followed as a result of this enormous dosage. It would appear that to be efficient the serum ought to be more potent than any which have yet been employed, and, until such a serum is manufactured, serum therapy does not offer many attractions. It is true that the cases in which it has been employed are too few to warrant any very definite statements being made, but at the present moment the disadvantages of the treatment seem to outweigh any possible advantage.

Where a contact with a definite case of small-pox develops definite symptoms of invasion, it is possible in certain cases to *abort the attack*, if the patient is seen on the first or second day of illness, by *vaccination*. After the second day of illness, it is useless to attempt this.

Diet.—The diet in small-pox differs in no way from the diet in any other acute infectious fever. During the febrile stage the patient must be kept on a diet consisting entirely of milk, with barley water and a little chicken tea. It is possible that an egg beat up in milk may be tolerated by patients even in the acute stages of the disease, but experience goes to show that the digestion of patients suffering from small-pox is weak, and that very little more than the ordinary fluid febrile diet can be tolerated at all.

Alcohol should not be used in anything like routine fashion, and should only be employed to tide the patient over an emergency of cardiac failure, or, in larger single doses, to induce sleep at night.

As convalescence becomes established, the appetite of the patient may be taken as a perfectly safe guide with regard to increasing the dietary. As fever subsides, light carbohydrate meals may be introduced in addition to the milk; eggs may be given, and, within a week of the subsidence of the fever, the patient should in most cases be able to tolerate an ordinary light diet, which includes lightly grilled chops, chicken and fish. At the end of another week, full diet may be given.

If the suppuration has been excessive some advantage may be obtained during convalescence by the addition of stout

to the dietary, but whisky or brandy, or any other form of alcohol, is no more necessary during convalescence from small-pox than during convalescence from any other acute fever.

In severe confluent cases the condition of the mouth may make any dietary other than fluid impossible for even a week or ten days after the subsidence of the secondary fever.

Epidemiology. — Small-pox may arise in this country at any time of the year, seeing that it is a disease that is always introduced from outside. But experience shows that an epidemic which begins in spring or early summer is usually of smaller extent than one which begins in autumn or winter. This may be accounted for by the fact that small-pox in this country arises invariably among the poorer classes, where overcrowding is the rule, and, while in summer windows are apt to be open and the people spend much of their time out of doors, in winter they naturally tend to herd together for warmth, and more opportunity is thus given for the spread of the disease.

Infection is usually by direct contact, but it may be spread also by fomites, notably, by infected clothing. The aërial convection of small-pox is a matter open to discussion, but it seems possible that it may occur, and it is a potent argument in favour of the proper isolation, not only of small-pox patients, but of small-pox hospitals.

The period of infectivity of small-pox lasts until the last crust has separated from the skin, and until the last core has been removed from the hands and feet. The separation of the crusts is usually complete in a moderate case of small-pox in about four weeks, and, in a very mild case, in some three weeks. But it is found in an epidemic that six or eight weeks is the ordinary period during which the patient must be kept isolated. In very severe cases, the crusts may not be completely gone until ten weeks or three months have elapsed.

The *death-rate* of small-pox varies very much according to the nature of the attack, and also with the age of the patient and the efficiency of the vaccination. In unvaccinated cases the younger the patient the higher is the death-

rate, up to the age of forty, when the death-rate again approaches that of infancy and young childhood. In patients who have been vaccinated only in infancy, the death-rate increases with age. Thus in unvaccinated patients the most dangerous periods are under five and over forty, while the least dangerous is between five and twenty, and in patients who have been vaccinated only in infancy, the mortality is practically nothing under ten years of age, very slight between ten and twenty, and thereafter increases steadily with age.

Small-pox hardly ever occurs in people who have been even once *successfully re-vaccinated*, and then the disease is usually of a very benign character. If a patient vaccinated only in infancy shows an efficient vaccination as estimated by the superficial area of the marks, the chances are that his attack of small-pox will be much less severe than an attack appearing in a person who shows an inefficient vaccination as estimated also by the superficial area. There is no doubt that efficient vaccination, even if performed only in childhood, does modify very considerably the mortality rate of small-pox as compared with the mortality rate of the disease when it occurs among unvaccinated people.

In estimating the efficiency of vaccination as indicated by the marks, one has to take into account the appearance of the scar as well as its extent. Well-marked foveation is a valuable index to efficient vaccination, and a well-foveated scar is reckoned to be evidence of much greater efficiency than a scar of similar superficial area which shows only a small amount of foveation and a large amount of ordinary smooth scar surface.

Second attacks of small-pox do occur, but are very rare, and the second attack is always benign, and usually quite definitely varioloid in character.

Home Prophylaxis.—In this country cases of small-pox are not permitted to be nursed at home, on account of the great danger that one case of small-pox is to a community if permitted to remain at home and form a definite nucleus for the spread of the disease.

Public Health Administration. — All patients suffering from small-pox must be immediately removed to an

isolation hospital. The contacts must be isolated, and observed twice a day. All articles of clothing, bedding and furniture that have been in contact with a patient suffering from small-pox must be suitably disinfected, or, if this is impossible from the nature of the article, must be destroyed. The house in which a small-pox case has occurred must be thoroughly disinfected by lime washing and by the use of formalin and sulphur, and walls must be stripped and repainted or papered. Any insanitary surroundings must be corrected, back-courts cleaned, ash-pits and ash-bins disinfected, and the neighbourhood must be carefully investigated for other cases.

The Public Health Authorities should place a skilled staff at the disposal of the practitioners of the neighbourhood for the immediate examination of any doubtful cases, so that no case may be missed. One mild unrecognised case is of more danger to the community than twenty severe cases which are recognised early and removed to hospital. All contacts should be immediately vaccinated, and vaccination should be urged upon the whole of the community in which small-pox has occurred.

Vaccination.—The trend of our legislation at the present moment would seem to indicate that the belief in vaccination has somewhat waned. Loopholes are given to the conscientious objector to a degree that makes one extremely apprehensive of the character and extent of the next great epidemic of small-pox. The percentage of unvaccinated children in large urban communities has increased enormously during the past ten years, and in this country small-pox has open to it to-day a field of attack larger than has been afforded it for a generation or two. It cannot be denied by those who have had any experience of small-pox epidemics that the greatest and the most powerful weapon which we have at our disposal for the prevention of small-pox is vaccination, and yet successive Governments have deliberately made evasion of the vaccination laws more and more possible, and have even modified these laws themselves. It is difficult to know what attitude the physician should adopt under these circumstances. It is possible that this country may be capable

of learning the lesson only by experience, and that only a large and severe epidemic of small-pox will convince a people who, fortunately for themselves, have never seen the effects of practically unmodified small-pox on a community, of the risk that they are permitting themselves and their powerless children to run. The arguments of the anti-vaccinator will doubtless have little effect before the ravages of such an epidemic, but it seems wrong that legislation should be capable of influence by a handful of ignorant faddists, when the whole weight of medical opinion is against their views.

In the days in which vaccination was done by the "arm-to-arm" method it is probable that contagious diseases were sometimes conveyed from an unhealthy to a healthy child, and such results were quite enough to give reasonable ground for alarm if such occurrences happened to be at all frequent. But the introduction of vaccination directly from the calf has removed all such risk, and there is now no room for such arguments against vaccination.

In pre-antiseptic days, too, there is no doubt that unnecessary suppuration and cellulitis sometimes followed on the operation of vaccination, and in careless hands at the present day, vaccination even with carefully-prepared calf lymph may be attended by considerable risk. But if the operation be performed with due consideration of asepsis, if, in other words, the operation of vaccination be performed with all the precautions necessary for any other surgical operation, infection of the wound by pyogenic organisms would be impossible. Calf lymph, as at present prepared, is, as far as pyogenic organisms are concerned, a sterile fluid, and if the practitioner takes ordinary precautions no suppuration should result. But it is necessary before vaccination to clean the patient's arm thoroughly with soap and water and methylated spirits, and the needle or other instrument used for making the inoculation should be either boiled or carefully sterilised by heat before vaccination is done. No blood should be drawn during the operation. For the success of vaccination it is sufficient to drop the lymph on the arm, and carefully scrape off the epidermis. There is no advantage,

but rather the reverse, in injuring the true skin. The arm should be allowed to dry in the air, and the scarified part should afterwards be covered by a pad of aseptic wool, after being dusted with an antiseptic powder. A mixture of equal parts of boric acid, starch and lycopodium makes a very useful application for this purpose. The pad of cotton wool may be renewed from time to time as necessity arises, and it may be kept in place by a bandage or strips of plaster. The much advertised shields are of no use, but are rather a disadvantage, since they tend, on becoming displaced, to rupture the newly-formed vesicles.

It is always well to impress upon the patient who is being vaccinated, if he be old enough to understand, or upon the parents of infants, that the patient may suffer some discomfort after the operation, and that during the time the vesicles are maturing the bowels should be freely moved, and the diet should be of a light character. Adults should be forbidden to take alcohol during this time, and warned carefully that should they transgress this rule they may suffer from severe inflammation of the arm. The only really bad arms which I have seen resulting from vaccination have been in patients who were naturally very dirty in their habits, or who were habitually intemperate.

As a necessary precaution against pyogenic infection of the scarified part, no practitioner should vaccinate a child (except in the infected areas of a community during an epidemic of small-pox) if there is any tendency to acne or eczema, or any other suppuration about the patient. The presence of an eczema capitis is quite sufficient reason for delaying vaccination, and the operation should never be performed until the child has been free from all trace of the disease for at least a week or ten days.

During the course of an epidemic, however, it will be found necessary to vaccinate many children in a condition which would otherwise delay the operation. During the course of an epidemic of small-pox I have had to vaccinate children and adults in all stages of illness who were suffering from one or other of the acute fevers other than small-pox,

and in no instance did I observe any evil effects following on vaccination. One point, however, is worthy of note, namely, that patients suffering from measles were curiously insusceptible. It was only perhaps after a second or third attempt that vaccination was successful in such cases.

The normal course of the local effects of vaccination are roughly as follows:—A little redness with some urticarial swelling usually occurs almost at once after the operation, but this will probably subside within twenty-four hours. On the third or fourth day papules make their appearance, and these, after four or five more days, develop into vesicles which on close observation are found to be multilocular, and are filled with a clear fluid. They are surrounded by a red areola of greater or less extent according to the susceptibility of the patient. This areola may be represented only by a narrow red line round the margin of the vesicles, but, on the other hand, it may be represented by a deep crimson blush extending for some inches around the site of inoculation, even where the vaccination is normal, and there is no contamination of lymph or skin by pyogenic organisms. On the ninth or tenth day of vaccination the vesicles become pustular, and are definitely umbilicated. Almost at once the centre begins to dry and a scab forms which grows rapidly outwards, and eventually covers the whole site of the pustules. Somewhere between the fourteenth and twenty-first day the scab, if undisturbed, falls off, leaving behind it a dusky red scar. This scar becomes white in the course of a month or two, and foveation of its surface becomes very apparent. The degree of foveation varies inversely with the amount of inflammation surrounding the vaccinated area.

As the vaccination matures there is always a slight degree of constitutional reaction. The patient suffers from a little malaise, with possibly some headache. The temperature may be raised, and appetite is often impaired. The constitutional symptoms reach their acme from the eighth to the tenth day, and then, in the case of a normal vaccination, rapidly subside. As a rule no further disturbance results, though in a certain number of cases the patient may suffer from a slight degree of diarrhœa.

Various rashes have been seen complicating the normal course of vaccination. The commonest of these are urticarial rashes of various kinds, limited areas of simple erythema, morbilliform rashes about the joints, and possibly widespread erythema or a generalised morbilliform rash. Occasionally, even after a healthy vaccination, these urticarial rashes may take on an appearance calculated to give rise to alarm on the part of the attendants. I have seen one case in which a rather widespread urticarial eruption became on the second day of its appearance a deep purple, and on the next day was almost black. There was no evidence of suppuration at the site of inoculation, the vaccinia running an absolutely normal course, but this particular child was suffering from whooping-cough at the time when it had to be vaccinated. The child suffered no constitutional disturbance in connection with the appearance of the rash, the vaccinia ran a normal course, the scabs were separated by the sixteenth day, the rash fading completely about the same time.

Vaccinia may become *generalised* either by auto-inoculation or by direct infection of other parts from the original site of inoculation. This is not a common condition, but when it does occur it may give rise to very serious disturbances, and death as a result has been recorded in a few cases.

Supernumerary vesicles round the site of inoculation are met with not infrequently, and rarely give rise to any more trouble than that which might be expected to follow on a great increase of the vaccinated surface. If scrupulous cleanliness is observed in the treatment of such cases, it is not likely that any ill will result.

Urticarial rashes may appear at any time from the second to the tenth day. Generalised vaccinia occurs somewhere about the end of the first week, usually just as the pocks mature.

The *number of marks* necessary for efficient vaccination is, as recommended by the Local Government Board, four, and certainly where the patients belong to a class where re-vaccination is improbable, it is wise to adhere to this recommendation. But where the patients belong to the intelligent and educated classes, and are likely to be under the more or less direct

control of a physician during their whole life, it is quite unnecessary to vaccinate so severely in infancy. One fair-sized mark will be found sufficient in most cases to protect the child for, say, seven or eight years. At the end of this time the child should be re-vaccinated, and re-vaccination should be again done somewhere about the end of school age.

It is most likely that a person who has been vaccinated in infancy, and re-vaccinated twice before the age of twenty, will be reasonably protected against small-pox for the rest of his life, even if only one of the attempts at re-vaccination has been successful. It stands to reason, however, that all people who find themselves near an epidemic of small-pox should be re-vaccinated at once, however successful attempts at re-vaccination have been previously.

Many children are insusceptible to vaccination on the first attempt in infancy, but no child should be finally considered as insusceptible until three or four attempts have been made before the child is a year old. A child who proves refractory to a first or even to a second vaccination is often successfully vaccinated on the third attempt. Failure of the first vaccination followed by a successful second attempt is extremely common in practice.

The possible dangers of vaccination, where good lymph is used and where proper surgical precautions are taken before and during the operation, are so remote that the general public has less reason to condemn vaccination than almost any other surgical procedure, and under these conditions it is extraordinary that an anti-vaccination campaign should be attended by even a tithe of the success it has at the present day. After all, vaccination and re-vaccination are the only sure and certain methods at our disposal just now for the eradication of small-pox, and any legislature gifted with even an average amount of commonsense should not only enforce the vaccination laws as much as possible, but should introduce an additional regulation insisting upon re-vaccination before the age of eighteen. If these precautions were observed the administrators of our large cities would not need to suffer, as they do now, from the dread of a great small-pox epidemic at no distant date.

Chapter XIX.

CHICKEN-POX.

Synonym. — Varicella.

German: Die Wasserpocken, Varicellen.

French: La Varicelle.

Definition. — An infectious disease characterised by fever and the appearance of a specific eruption, which is vesicular in character, and usually appears in successive crops. No specific micro-organism has been isolated in this disease.

Incubation. — The incubation period of chicken-pox is most usually fourteen days, but it may be as short as eleven and as long as twenty-one days. Fourteen days is by far the commonest period of incubation.

Rash. — The rash of chicken-pox usually appears between the first and the third day of the disease. In children it is usually the first indication of illness. It may appear all at once, but this is not common, except in those cases where the eruption is very scanty. In the great majority of cases successive crops appear from day to day, and usually there are not more than two or three, or at the most four, of these crops.

The rash usually makes its appearance first on the back, chest and abdomen, then spreading to the face and limbs, but in a minority of cases it has been seen to appear first on the face and limbs, afterwards spreading to the back, chest, and abdomen.

The eruption consists at first of small pale red papules, which disappear on pressure. Certain of them have even at the beginning a central acuminated appearance at the point where the vesicle afterwards appears. The papules develop almost at once into vesicles which are unilocular and have a

very thin envelope. They are filled with an extremely clear fluid, like water, and are usually slightly oval in shape, with, at times, an irregular edge. The vesicle is very superficial for the most part, except on the scalp, forearms, hands and feet, where it is rather more deeply set in the skin, and may be rounder, harder, and smaller in these situations than elsewhere on the body, thus closely resembling in many cases the eruption of small-pox. The vesicles are very easily ruptured; so easily, indeed, that they seldom survive friction and scratching long enough to become definitely purulent.

When the vesicle remains unruptured, it becomes purulent in a couple of days, and very speedily begins to dry up, at first in the centre, where a scab forms which spreads rapidly to the periphery. The crusts are usually dark in colour, and retain more or less an oval, or sometimes an irregular, shape. The crusts fall off in from three or four days to a fortnight as a rule, but some crusts may adhere for three or four weeks.

The eruption, as has already been described, appears in successive crops, so that at the end of three or four days a few square inches of skin, say, on the back, may present all stages of the eruption, from papules to scabs.

Symptoms of Invasion.—Beyond an hour or two of malaise, and possibly a little fever, it is not common in the case of children to have any very definite period of invasion in chicken-pox. Indeed, in most cases the appearance of the rash is the first indication of the disease.

In adults, however, the symptoms of invasion may be very definite, and may last for two or three days. Headache, general malaise, high fever, vomiting and aching in the body and limbs may be present for some days before the appearance of the eruption. As the eruption appears the symptoms of invasion subside rapidly, and as a rule the discomfort of the patient is at an end.

Clinical Types.— The classical type of chicken-pox is that in which the eruption appears on the back, chest and abdomen, afterwards invading the face and limbs, with no period of invasion, or at the most a few hours of discomfort.

The temperature may or may not be elevated. In many cases where the eruption is the first sign of the disease the

temperature may not be raised until two or three days after the appearance of the rash. In such cases the rise of temperature is coincident with the suppuration of the vesicles. The temperature is only slightly elevated and falls to normal again in about a couple of days. If the rash is very profuse the temperature may be raised as the papules appear, falling again as the vesicles develop, and rising once more as the pustules form. This type, as will be seen, resembles very closely the pyrexia of small-pox. In those cases which have a definite period of invasion the temperature often rises gradually from the first appearance of the prodromal symptoms until the vesicles are fully developed, and pustulation occurs. As crusting proceeds the temperature falls by lysis. In such cases there may be no definite period of apyrexia separating the primary from the secondary fever. The height of the temperature varies very much. In many cases the disease may run its course without any real elevation of temperature at all. In more severe cases the pyrexia is moderate, rising, say, to 100° or perhaps 101° F., while in certain severe cases the temperature may rise to over 104° F. or even higher at the acme of the disease.

Even in severe cases the behaviour of the rash is very much as has been already described, the only difference being that certain of the pustules lead to a destruction of the skin comparable to that met with in small-pox, and on the separation of the crust definite pitting with a foveated scar may be seen. Such a scar is usually oval or of an irregular outline, the long axis of the oval mark being as a rule in a line with the natural folds of the skin. It is not usual for more than a very few of these marks to be left even after a severe attack of the disease.

As has been said before, chicken-pox with a definite period of invasion is met with much more commonly among adults than among children, and chicken-pox may be in adult life a disease of some severity. Among adults, too, the distribution of the rash may be a little abnormal. It is among adults that a rash composed of small, deeply-set elements is chiefly met with, having a distribution on the face and forearms more profuse than normally. Among adults, too, and

even among children, although more rarely, vesicles are sometimes found on the palms of the hands and on the soles of the feet, and cases of this kind are not infrequently confused with small-pox.

As is the case with all the acute fevers, chicken-pox may develop a *grave type,* and the two most severe forms of the disease are the *hæmorrhagic* and the *gangrenous.*

The hæmorrhagic type of chicken-pox is extremely rare; the vesicles are few in number, and hæmorrhages occur in the skin and into the bases of the vesicles. It is said by those who have seen something of this type of the disease that, although it is serious, it is not usually fatal.

The *gangrenous* type of the disease is also uncommon, but is sometimes seen when chicken-pox attacks children who are badly nourished, or who are suffering from the effects of an attack of another infectious fever, such as tuberculosis or scarlet fever. In this type of the disease the pustules mature in the ordinary way, but certain of them become infected with pyogenic organisms. They enlarge considerably beyond the normal size, and become surrounded by a deep, angry, inflammatory zone. A thick black crust forms, and purulent material forms beneath it and oozes from under its edge. On the separation of the crust a deep, ugly-looking, punched-out ulcer is left, with a sloughing base, and thick unhealthy looking edges, usually deep red or purple in colour, which may slightly overhang the base. Such an ulcer may penetrate the whole depth of the subcutaneous tissues, leaving the muscle exposed. They vary in size from about half an inch to some two inches in diameter. Their outline is roughly circular, but the edges are usually somewhat irregular. The ordinary situation of the ulcers is on the abdominal wall or on the back. Such ulcers are quite evidently due to some cause outside the specific infection of chicken-pox, and are simply the result of a local destructive lesion produced probably by ordinary pyogenic organisms in patients whose resistance to infection has been greatly weakened both by the attack of chicken-pox and by some antecedent disease which has overtaxed their tissues. Many such cases die of a slow septicæmia, and even among those who recover the process

of repair both local and general is very slow, and the course of the illness is attended by much wasting. The ulcers in a gangrenous case leave ugly, puckered scars on healing.

Complications. — There are practically no complications which arise in connection with an attack of chicken-pox. Broncho-pneumonia and bronchial catarrh are probably accidental, if they do occur, and laryngitis, which sometimes occurs as the eruption develops fully, is very rare. Albumin may be present in the urine, but it is usually a transient symptom, and probably toxic in origin. Severe laryngitis, associated with œdema of the glottis, has been described as occurring in severe cases of chicken-pox, but the condition is very uncommon.

Sequelæ. — A certain amount of cachexia may persist for some weeks after a severe attack of chicken-pox, but beyond this the only sequelæ worth mentioning is *nephritis*, which has been observed by several writers. It seems likely that the nephritis may, as in the case of scarlet fever, be due to the specific infection, and in general resembles in type that which complicates scarlatina.

Diagnosis. — The diagnosis of chicken-pox is usually very easy, particularly if the patient is seen early in the disease. The typical vesicle, with its oval shape, superficial situation, delicate envelope and watery contents is very characteristic, and the appearance of the vesicles in successive crops after a very short papular stage and practically no period of invasion, makes the disease, if it is typical, easy of diagnosis.

The characteristic distribution of the rash is an important aid to diagnosis. In addition to what has been already said on this score, it is well to remember that in chicken-pox the flanks are usually well covered with the eruption, and the axillæ are frequently invaded by the rash.

The differential diagnosis between chicken-pox and *small-pox* has already been considered at some length in the chapter on small-pox, but it may be well to mention again some of the points of importance when such a differential diagnosis falls to be made. If a patient under ten years of age, with good

vaccination marks, has a profuse eruption, it is almost impossible that the condition can be anything but chicken-pox. A scanty eruption in such a patient might possibly lead to some difficulty, but in chicken-pox a scanty eruption is scarcely ever preceded by any notable period of invasion, whereas in small-pox the period of invasion is usually well marked and possibly severe although the eruption may afterwards be very scanty. The fact that recent vesicles in chicken-pox scarcely ever show any umbilication affords another distinction between them and the vesicles of small-pox, which are usually, even at an early stage, definitely umbilicated. The vesicles of chicken-pox are very fragile and easily ruptured by pressure; the vesicles of small-pox are firm, and a considerable amount of effort is necessary to rupture them by pressure of the finger. The eruption of chicken-pox is most profuse on the trunk and abdomen, and the axillæ may be invaded; whereas in small-pox the face, forearms, hands and feet show an eruption which is much more profuse than on the trunk and abdomen, while it is very unusual to find a small-pox vesicle on the axillæ. The characteristic oval or irregular edge of the chicken-pox vesicle is in striking contrast to the rounded vesicle of small-pox.

Chicken-pox may be also confused with *impetigo* and *herpes*. *Impetigo* is only likely to be confused with chicken-pox in the crusting stage. The presence of one or two typical vesicles would place the diagnosis beyond question. In impetigo the pustules and crusts are usually more profuse on the face than elsewhere, but in certain cases they may be sufficiently numerous on the body to give rise to some difficulty. The fact that the crusts were oval would be in favour of the disease being chicken-pox, but where the chicken-pox crust has formed and been removed and re-formed perhaps several times, the oval character is apt to be lost, and since at this stage of the disease it is not likely that any vesicles will be present, it is sometimes quite impossible to make a definite differential diagnosis. The patient must be isolated on suspicion.

In the case of *herpes*, the localisation and characteristic grouping of the vesicular elements is usually sufficient to make

a definite diagnosis possible on a reasonably careful examination.

Pemphigus in the early stages, when the bullæ are small, may closely resemble chicken-pox, but in most cases large characteristic bullæ soon make their appearance and render diagnosis an easy matter.

Treatment. — For convenience of isolation a patient suffering from chicken-pox should be kept in bed at least until the crusts are completely formed. Beyond keeping the patient reasonably warm and paying attention to the bowels, no special treatment, other than rest, is required. If there is much itching of the skin a simple dusting powder may be used, or a little zinc ointment. In gangrenous cases the ulcers should be dressed with large, moist, antiseptic dressings.

Diet. — In all cases of chicken-pox of moderate severity an ordinary light diet may be employed, not necessarily fluid. Where the fever runs high, however, it is well to keep the patient on a fluid dietary until it has subsided, when an ordinary light diet may be given. In gangrenous cases, after the primary fever has subsided, feeding should be liberal, and malt and iron will be found useful in promoting convalescence. It may be necessary in such cases to give small quantities of alcohol should there be any sign of cardiac failure.

Epidemiology. — Chicken-pox is endemic in most towns, and frequently shows an epidemic prevalence. Such epidemic increase may appear any time of the year, but is possibly most common in the autumn. It may attack patients of any age, but is certainly commoner during the first ten years of life than at any other period.

It is highly infectious, and the infection, although usually conveyed directly from person to person, can undoubtedly be carried by a third person who is not suffering from the disease, and can also be carried by clothing and other infected material. The infection is more short-lived than in the case of small-pox.

It is presumed that the infection, as in small-pox, is carried by the crusts. This may or may not be true, but it is the usual plan to consider the patient infective until all the crusts have separated.

Death never results in uncomplicated cases of chicken-pox, and it is only the gangrenous cases which are at all likely to be fatal. As the gangrenous cases occur only in marasmic children and in those who are convalescing from a severe illness, such as the septic type of scarlet fever, or are the subject of tubercle, it is always a difficult matter to say to what degree the antecedent disease has influenced the mortality in such cases.

Second attacks of chicken-pox do occur, but are certainly very rare.

Home Prophylaxis. — The patient should be isolated from other members of the household, and should be under the care of a separate attendant until the last crust has separated from the skin. All articles which are in the room or have been at any time in contact with the patient must be carefully disinfected before being washed, and the attendant should wear an overall and keep it in the room, taking it off before going out, and putting it on when she re-enters the sick-room.

Public Health Administration. — The room in which a case of chicken-pox has been nursed must be carefully disinfected in the ordinary way before the house can be considered free from infection.

While hospital accommodation is not usually provided for cases of chicken-pox, it may be found necessary where the disease has broken out in a very poor locality to remove children to hospital for their own sakes rather than for the sake of the community. All local authorities should be prepared to afford accommodation for this purpose.

All children who have been exposed to the infection of chicken-pox should be quarantined for twenty-one days, or to be perfectly safe, for twenty-five days, before being allowed to go to school.

Seeing that the disease is so benign, any systematic disinfection of areas by the local authorities is quite unnecessary. Chicken-pox, as far as the community is concerned, is only important on account of its resemblance to the graver disease, small-pox.

Chapter XX.

TYPHUS.

Synonyms.—Spotted fever; gaol fever.

German: Exanthematischer Typhus; Fleckfieber.

French: Typhus exanthématique.

Definition.—An acute specific fever, highly infectious, characterised by a measly and petechial eruption, marked mental symptoms and great prostration, running a course of about fourteen days. No specific micro-organism has been isolated in this disease.

Incubation Period.—The incubation period of typhus fever is about twelve days. In a few rare cases it has been recorded to have been as short as four or five days, and in others as long as three weeks. For purposes of isolation and the detection of the origin of an epidemic, it is the practice in this country to consider fourteen days as the usual incubation period.

Rash.—The eruption of typhus appears first on the fourth and fifth day of the disease, and is, at this stage, definitely morbilliform in character. In consists of spots or maculæ which are at first slightly elevated above the skin, and which disappear on pressure. These spots make their appearance first of all about the margin of the axilla and on the wrist, then the flanks are invaded, and afterwards the chest, back, shoulders, thighs and arms.

The spots are irregular in size and outline. They are of a pale dusky red in colour, and do not present a very definite margin, but tend to fade gradually into the normal skin which surrounds them. In addition to these definitely elevated spots

a dusky subcuticular mottling is apparent, occupying, roughly, the same areas as the morbilliform elements of the rash. These slightly elevated spots and the subcuticular mottling together constitute the "mulberry eruption" described by Sir William Jenner. When this rash is present in its classical form it is extremely characteristic, but in many cases the morbilliform elements are almost entirely wanting, and only the subcuticular mottling is apparent.

Somewhere about the end of the first week, between the eighth and ninth day of the disease, the maculæ become dark in colour, and tend to be "fixed." In addition to this change of appearance in the original eruption, petechial spots appear either in the centre of the irregular blotches already mentioned, or, as occurs in many cases, on the flanks, the axillary margins, the chest, the arms, the back, and the thighs, quite independently of any previously existing rash. In the strictly classical type of the disease, where the mulberry rash has been well marked, the petechiæ usually occupy a position more or less corresponding to the central portion of the morbilliform blotches. In the more modified typhus, however, with which we are perhaps more familiar nowadays, it is common to have practically no morbilliform rash at all; the mulberry eruption is expressed only by a profuse subcuticular mottling, and the petechiæ appear as described above, without any very definite association with the pre-existing rash.

If the petechial elements of the rash are not very abundant, the eruption begins to fade about the tenth day, but some staining of the skin persists as a rule for some days at least after the crisis. If, however, the petechial character of the rash be well marked, staining will persist for a much longer period.

Period of Invasion.—The invasion of typhus is, in the large majority of cases, like that of pneumonia, sudden and severe. The patient is seized with headache, nausea, and vomiting, and a marked sensation of cold, amounting in the majority of cases to actual rigor. Pain in the back and limbs and *tinnitus aurium* are very frequently present. So sudden is the onset of the symptoms of invasion that the patient can often tell the actual hour at which he took ill. In

most cases the patient feels perfectly well before the appearance of these symptoms, but sometimes the actual onset of the disease is preceded by a few days of general malaise, with vertigo, headache and anorexia.

After the onset of the attack the patient's sleep becomes disturbed and broken by dreams. Actual sleeplessness is quite common. Appetite is lost, and the mental faculties are dulled, so that the patient is stupid, answers questions incoherently, and during the snatches of sleep which he obtains tends to talk in a rambling way. There is, however, at this stage of the disease, no tendency to violent delirium. The patient suffers from loss of appetite, constipation, and very frequently from persistent and troublesome nausea, although vomiting is not usual. The tongue is coated with a white fur, the pulse is rapid and full, and the frequency of the respiration is greatly increased. The face at first is dusky and congested looking, the eyes are injected and rather watery; the expression at first indicates mere weariness, but at the end of the first day or so becomes listless, heavy, and rather sullen. As the period of invasion advances, the expression of the face grows vacant and indicative of mental confusion. Sometimes, as the time for the appearance of the eruption approaches, the expression becomes wild and anxious, and the whole aspect of the patient betokens the onset of severe nervous disturbance. As the pre-eruptive stage of the disease comes to an end, the face grows duskier in colour, and, although still flushed and congested looking, presents the "earthy hue" which is so typical of the facies of typhus.

Clinical Types.—After the period of invasion is over, and the disease is thoroughly established, that is, about the fourth or fifth day of illness, the rash appears, and the patient begins to show signs of great nervous excitement. He grows restless, wakefulness becomes even more marked, and delirium sets in. As is common in all fevers, with the onset of delirium headache disappears.

Between the fourth and fifth day the tongue becomes dry and brown, *sordes* collect on the teeth, lips and gums, and the breath has an extremely offensive smell. The amount of sordes usually varies directly with the severity of the attack.

Towards the end of the first week delirium usually becomes more marked. It is sometimes noisy and maniacal, while in other cases it closely resembles delirium tremens, and is accompanied by great muscular restlessness and tremor, and the patient may talk incoherently and incessantly. In certain cases, again, the delirium is almost from the beginning of a low muttering character. Restlessness and excitement are most marked as night comes on, and the patient tends to be more prostrated in the mornings. Delirium, of one kind or another, usually persists until the crisis of the disease, or until death occurs.

Somewhere about the tenth day the more active delirium and restlessness are replaced by a state of profound mental and physical prostration. It is during this period, which lasts until the time of the crisis, that the most dangerous stage of the disease is entered upon. The patient lies on his back, sunk in the bed. He is quite careless of his surroundings, and mutters incoherently to himself, and the expression of his face is dull and apathetic. The eyes are injected, and the pupils are usually extremely contracted. The tongue is dry, shrivelled, and brown, sometimes almost black. There is marked tremor of the muscles, and *subsultus tendinum*, with spasmodic twitching of all the muscles particularly of the face, and picking at the bed-clothes, are common symptoms of grave import. Obstinate hiccough is often present, and is a sign of great gravity. Involuntary evacuations of both bladder and bowel are common, the pulse is rapid, very small and easily compressible, while the respirations are shallow, rapid, and at the same time noisy. It is just before this phase of the disease develops that the eruption tends to become "fixed," and definite petechiæ appear.

In favourable cases *crisis* occurs about the fourteenth day, and there is a more or less sudden improvement in the condition of the patient. The temperature falls, the wakeful delirium passes away, the skin, which has been harsh and dry all through the attack, grows moist, and the patient very often falls into a natural sleep, which may last for many hours, and from which he awakes, weak and prostrated but conscious of his surroundings. The tongue grows moist, loses

its shrivelled appearance, and begins to clean at the edges and tip. The mouth becomes clean, sordes can be successfully removed, and do not tend to collect again, the breath loses its offensive smell, the eyes become clear, and the pulse grows fuller and less rapid. As in pneumonia, "critical discharges" are quite common, profuse drenching sweats may occur, the bowels may suddenly show a tendency to looseness, and the urine, which during the whole of the attack has probably been scanty and highly coloured, although fairly clear, is passed in greater quantity, and may be loaded with urates and uric acid.

After the occurrence of the crisis the patient enters rapidly upon the *stage of convalescence.* The tongue cleans, muscular strength returns, and appetite grows with extraordinary rapidity. In many cases the appetite of the patient convalescent from typhus fever is excessive, and he can scarcely be satisfied with food. In the majority of uncomplicated cases the patient regains health and vigour very rapidly, so that in three or four weeks convalescence may be complete.

The *temperature* in typhus fever follows, in classical cases, a very definite and regular course. It rises somewhat rapidly during the period of invasion, reaching a height of 103° or 104° F. by the fourth day. This ascent is commonly by "steps and stairs." While the temperature on the second day of the disease is usually definitely febrile, in some cases the onset of the pyrexia is very gradual, so that even at the end of the second day it may be only raised to about 100° F. By the fourth day, however, it is always high, and may reach 104° F. or even higher. Hereafter the fever is a "continued" type until early in the second week of illness, usually between the seventh and tenth days, when there is frequently a well-marked remission, or "pseudo-crisis." In most cases this pseudo-crisis is followed by a second rise in temperature about the eleventh day, and the fever again assumes a "continued" type until the final stage of defervescence begins. In favourable cases the second rise in temperature does not reach the same height as during the first period of continued fever. In some instances the pseudo-crisis is followed by a gradual lysis until the normal is reached on or about the fourteenth day.

The most usual termination of the fever is, however, by a distinct crisis, which follows on the second period of continued fever, and which begins somewhere between the thirteenth and fourteenth day, and finishes between the fourteenth and fifteenth. In some cases the crisis is extraordinarily rapid, and the temperature may fall in a few hours, certainly within twenty-four, from a highly febrile register to normal or subnormal.

In certain very mild cases of typhus the fall in temperature which occurs early in the second week of the disease may be complete and final, and a true crisis may terminate the attack at this period. On the other hand, in certain severe cases there may be no such remission of temperature between the seventh and the tenth days, and the pyrexia at this time may steadily increase, and death may occur before the fourteenth day, with very pronounced hyperpyrexia.

The *pulse* all through the attack varies more or less correctly in the majority of cases with the degree of fever.

One feature of typhus fever which is not common to all the infectious fevers is that in this disease the *odour* of the patient is in many cases characteristic. The odour has been described as "mousy," or like the smell of rotten straw, and, to those who are familiar with typhus, it is strikingly characteristic. I have heard the late Dr. J. B. Russell, formerly Medical Officer of Health for Glasgow, say that in the old days, when typhus was rife in that city, he was able, more often than not, to know that a typhus patient was in a room simply by the smell. This odour appears to be given off from the skin, and is probably present at one time or another during the course of the disease in all cases of typhus, except those of a very mild type. It may even persist during the period of convalescence.

While the odour is in my opinion only slightly reminiscent of the smell of mice, a note made by Brownlee of Glasgow in a recent report would seem to show that there is considerable reason for this description of it. A large cupboard in the administrative office was occupied by old bed cards from all the wards in Belvidere Fever Hospital. The place was infested with mice, and it is interesting to note that, although

the bed cards were collected from all the wards of the hospital, and represented patients suffering from all the infectious fevers, it was only those cards which had come from the typhus wards which were nibbled by the mice; the others had been left severely alone.

The clinical description of typhus fever given above is that of the ordinary classical type of the disease, but the disease may present features of greater or lesser severity than have been included in that description.

A *fulminant type* is sometimes met with, in which the patient is struck down with extraordinary rapidity, and may become comatose in a few days, dying, as a rule with high fever and a rapidly failing pulse, just about the time the eruption should appear, or only a day or so afterwards. This type of the disease is with difficulty recognisable unless the case arises in conjunction with other definite cases of typhus.

A *severe type* of the disease is that in which signs of nervous excitement with restlessness and delirium set in earlier than usual, and in these cases death may occur on or about the twelfth day of illness. For some time before death the patient sinks into a condition of coma, lying with open eyes, which have a vacant look, with widely dilated pupils. The mouth is open, the face pale and livid; the pulse is very rapid and weak, and may be imperceptible at the wrist; the breathing is very shallow; the surface of the body generally is cold and clammy, and sometimes bathed in sweat. Death always occurs when this stage of wakeful coma is reached. In other cases which begin similarly there is no such wakeful coma, but the patient dies after sudden and extensive congestion of the lungs. In other cases, again, the heart may fail suddenly; the surface of the body becomes cold and livid, and the patient may suffer from profuse sweating.

In many of these severe cases the temperature may be quite moderate, perhaps not exceeding 101° or 102° F. It is sometimes irregular in character, with considerable daily variation, while in other cases the fever may be "continued" with practically no morning remissions. In those cases where cardiac failure is marked, the range of temperature often tends to become lower, while at the same time the pulse rate rises.

In certain severe cases, on the other hand, the temperature may run more or less the usual highly febrile course, until between the twelfth and fourteenth day it begins to fall by a rapid lysis, with, however, no amelioration of the patient's symptoms, death occurring with gradually increasing coma and a rapidly rising pulse rate.

In great contrast to those severer forms of the disease are the *mild forms* which are very often seen in children, and not infrequently nowadays in adults. In such cases the course of the disease is usually distinctly shorter than in the classical type. The temperature falls to normal as a rule between the seventh and twelfth days, either by crisis or by a rapid lysis. Termination by lysis is very common in children. In those mild cases the rash is usually scanty, and may consist only of subcuticular mottling, followed in due course by the appearance of a few petechiæ. The patient may not lose consciousness during the whole course of the fever, although there may be considerable pyrexia from the fourth or fifth day until the termination of the attack. There may be no signs of nervous excitement, and no indication of cardiac weakness.

During the course of an epidemic of typhus cases may be met with which present no definite signs of disease beyond headache, nausea, and general malaise, with some rise of temperature. In these cases the attack may last only for about a week, and the type of the disease is perhaps best described as *typhus febricula*.

There are certain unfavourable signs in the course of a case of typhus which may be mentioned with a view to *prognosis*.

A *history of alcoholism* always makes the prognosis grave, and any *pre-existing cardiac lesion* is a heavy weight for the typhus patient to carry. There is no doubt, too, that a *large and heavy person*, whether muscular or merely fat, has a worse chance of weathering an attack of typhus than a person who is spare and of slight build. Indeed, one has often seen a spare, wizened alcoholic recover from an attack of typhus, while a heavy, bulky man of strictly temperate habits has succumbed.

Severe nervous symptoms, especially wild delirium and coma, point to a fatal termination, and *subsultus tendinum, carphology,* and *pronounced muscular twitching* are also of bad omen.

A pulse-rate over 120 is an unfavourable sign, as is also a respiration rate which approaches or exceeds 40 in the minute.

A patient who sleeps badly has much less chance of recovery than a patient who gets a fair amount of sleep.

Pinhole pupils are also an unfavourable indication.

A *profuse eruption* with many petechiæ suggests a severe infection, and *hypostatic staining of the back* denotes a degree of circulatory stasis which is an immediate precursor of death.

A temperature which shows very little morning remission usually indicates a case of greater gravity than when the morning remissions are well marked, and should the temperature tend to rise rather than fall about the time when the crisis may occur, it may be taken as a very unfavourable indication.

Profuse and continuous sweating at the time of the crisis is suggestive of profound asthenia, and lividity of the skin, paralysis of the sphincters early in the second week of illness, and hiccough are all signs of the gravest import. An absence of the cardiac impulse, with a first sound that is practically inaudible at the apex, indicates a degree of cardiac weakness so great as to make it extremely unlikely that the patient will weather the attack.

Complications. — The more common complications of typhus are in connection with the *respiratory tract,* the *heart,* and the *kidneys. Venous thrombosis* and *lymphangitis* are very common in some epidemics, and *parotitis* is also not unusual.

Of the complications connected with the *respiratory tract,* bronchitis is the most frequent. It is widely diffused, and affects not only the larger but the finer bronchi. This, combined with the tendency to hypostatic congestion of the lungs which is such a common feature of the disease, may give rise to a condition of great gravity. The patient lies naturally in the dorsal decubitus in typhus, and this position, combined

with his great muscular weakness, makes it very difficult for him to clear the bronchi of secretion, the more so as secretion in cases of typhus complicated by bronchitis is usually very profuse. This complication may arise at any time in typhus after the first few days, and is a very common cause of death. The patient becomes cyanosed, breathing becomes increasingly difficult, and death occurs either just before the crisis is expected, or as it occurs. Sometimes the bronchitis is slight, affecting chiefly the larger bronchi, and may not influence the course of the disease unfavourably. The occurrence of bronchitis, however, early in the attack, especially if it be at all diffuse and if the finer bronchi are affected, should always lead one to give a grave prognosis.

An *acute pneumonia* of the lobar type is also sometimes seen, but is rare. When it does occur it is a sign of extreme gravity, and usually leads to a fatal termination.

Laryngitis is another complication which is not common, but is extremely dangerous, largely on account of the fact that *acute œdema* of the glottis may occur in such cases with rapid suffocation, or *necrosis* and *gangrene of the laryngeal cartilages* may result. Death very frequently follows on the occurrence of these complications, which are indicative of an extremely profound toxæmia.

Gangrene of the lung has been known to occur, and *pleurisy* is sometimes met with, usually accompanied by an effusion which rapidly becomes purulent.

A rare and interesting complication is *hæmoptysis*, which is usually seen in cases which present otherwise a hæmorrhagic type of the disease, and is due probably to alteration in the condition of the blood and weakening of the vessel walls from the action of the typhus poison.

While *endocarditis* and *pericarditis* are rarely met with in the course of typhus, *cardiac distress* is very common, and is due to the effect on the cardiac muscle of the typhus toxins. This may be so severe as to cause an *acute granular disintegration of the muscular fibres*, with rapid and complete heart failure. From the date of the appearance of the rash, even in favourable cases, the heart is weak in action for about a week. In favourable cases, however, there is some recovery of cardiac

strength before the crisis occurs, and with the crisis evidence of cardiac distress disappears. In unfavourable cases, however, cardiac weakness becomes increasingly apparent from the time of the appearance of the rash until the fatal termination of the attack, which may be just before the time at which the crisis is expected, or at the time of its occurrence, when a falling temperature and a rising pulse rate give indication of the approaching end.

Simple *albuminuria* is so common in the course of the fever as not to be reckoned as a complication, but in some cases a true *nephritis* occurs, with hæmaturia, profuse albuminuria and tube-casts, accompanied by signs of *uræmia*. Death may ensue in such cases after the occurrence of convulsions and coma, which are probably uræmic in origin. *Cystitis* is sometimes seen, and is secondary, as a rule, to great weakness of the bladder wall, with resulting over-distention and incomplete emptying of the bladder. At times cystitis has been known to be associated with *hæmaturia*. *Hæmaturia* may also result in a hæmorrhagic or hæmolytic type of the disease from the altered condition of the blood and small vessels.

Thrombosis of one or other of the *femoral veins* is not uncommon, but it is probable that most cases of "white leg" which occur in the course of typhus are due, as in enteric fever, not to venous thrombosis, but to a *diffuse lymphangitis*. In some epidemics "white leg" is a comparatively common occurrence.

Parotitis is another complication which is not infrequently seen. It usually results in suppuration, with sloughing of the surrounding parts, and is a sign of a grave infection, although it does not necessarily indicate a fatal termination. Parotitis usually appears some days before the crisis is expected, but it may also occur early in convalescence.

Bubonic swellings of various groups of lymphatic glands sometimes occur, and their commonest situations are in the cervical region and the groin. They appear, like parotitis, either shortly before the crisis is expected, or very early in convalescence, and they may either suppurate or subside without suppuration. When suppuration occurs, it is frequently associated with a considerable amount of sloughing and

gangrene of the surrounding parts, and a very ugly sore results which may take a long time to heal.

Diarrhœa may be sometimes so urgent as to warrant its being considered a complication of typhus, and is, in the weakened state of the patient, a grave danger. *Hæmorrhage from the bowel* and *hæmatemesis* may occur, but are uncommon, and indicate a hæmorrhagic type of the disease rather than the existence of any local lesion.

Otitis media, small multiple pyœmic abscesses and troublesome crops of *boils* are also occasionally met with, either towards the end of the fever or at the beginning of convalescence.

Although nervous symptoms are so usual in the course of the disease, any gross lesion of the nervous system is rare. *Meningitis*, however, may occur, and *hemiplegia* may result from cerebral hæmorrhage, embolism, or thrombosis.

Jaundice is a rare complication which invariably indicates a fatal termination for the disease.

Sequelæ.—Beyond the occurrence of *venous thrombosis, parotitis, bubonic swellings* of lymphatic glands, *boils*, and other indications of pyogenic infection, the sequelæ of typhus fever are few, and convalescence is usually rapid and complete after the occurrence of the crisis.

In some rare instances, however, various sequelæ may occur in connection with the *nervous system*. *Peripheral neuritis* is probably the cause of the muscular pains which sometimes complicate and protract convalescence. *Paraplegia*, with increased knee reflexes, has also been noted occasionally in patients convalescent from typhus. Some degree of *mental weakness*, or even more rarely, *mania*, may occur as convalescence is established. Fortunately, all these conditions are quite transient, and even mental weakness and mania rarely persist longer than a few months. In a few instances, however, it would seem as if the mental attitude of the patient had been permanently changed by the attack of typhus. Such an occurrence is, fortunately, of extreme rarity.

Diagnosis.—When an epidemic of typhus is in progress, diagnosis of the disease, even at an early stage, is not as a rule a very difficult matter. The heavy congested face, injected

eyes, and confused mental state are all very suggestive, and if in addition the attack has been ushered in by headache, shivering, and vomiting, the presumption of its being a case of typhus is very strong.

In the early eruptive stage the classical rash is very characteristic, but it is to be remembered that it may consist only of a subcuticular mottling, which is difficult to recognise, except after considerable experience.

If the morbilliform elements of the rash are well marked it is possible that the case may be confused with *measles*, although the early catarrhal symptoms in measles and the profuseness of the rash should make such confusion difficult. Moreover, measles is essentially a disease of childhood, and the rash in children is quite as profuse as in adults, whereas in typhus fever the morbilliform rash in children is slight, modified and sometimes entirely absent.

The petechial elements of the rash resemble the fixed eruption met with in *hæmorrhagic enteric fever*, *true purpura* and the *purpuric rash* which appears in certain non-specific infections, which may produce leukæmia or other profound blood changes. It also resembles very closely the petechial marks left by *flea bites*, but a careful examination of a flea bite will usually show a small central point which indicates the original puncture. Otherwise, in size and general appearance the petechial stage of a flea bite resembles very closely the small petechia of typhus, but the distribution is somewhat different, being more profuse as a rule on the arms and legs than on the trunk, although in many cases the whole body may be covered. It is to be remembered, also, that among the class of patients who are usually afflicted nowadays with typhus, bites from vermin are the rule, and one rarely finds a case of typhus fever where the true rash is not accompanied by a profuse crop of flea bites.

In true purpura and in hæmorrhagic typhoid the petechial eruption is composed as a rule of larger elements than are commonly found in typhus.

The two diseases with which typhus is most commonly confused in this country are *acute lobar pneumonia* and *enteric fever*.

An apical *pneumonia* may present no physical signs in the early days of illness, and, as cases of apical pneumonia are so frequently accompanied by early mental disturbance and even delirium, it may be very difficult to make up one's mind as to the nature of the case. Pneumonia is a disease whose onset is as rapid and severe as that of typhus, and an apical lesion is not likely to be associated with early pain in the chest on account of its central beginning. In pneumonia, too, the face may be congested and flushed, and although in such cases herpes of the lip is very common, such an occurrence is also not unusual in typhus. An eruption of flea bites may further confuse diagnosis. In the course of a day or two, however, the lesion in the lung will declare itself, and the greatly increased frequency of respiration in early cases of pneumonia, combined with dilatation of the nostrils during inspiration, will make one suspect the presence of an acute pulmonary lesion. On the other hand, it is not uncommon to find a case of typhus sent to hospital as pneumonia, the physician having been misled by the sudden onset and acuteness of the fever, and by the finding of an area of dullness at the base of one or other lung behind. Such areas of dullness are very common in typhus, even at an early stage, on account of the tendency to hypostatic congestion of the lungs, and the auscultatory signs over such areas of impaired percussion, namely, diminution in volume of the respiratory murmur and a little inspiratory crepitus, are just such as one might expect in the early stages of a pneumonia. Early mental confusion with delirium is common in both diseases, especially in alcoholic subjects.

The main points which one must consider in a differential diagnosis of lobar pneumonia from typhus are the rapidity of the respiration, which is quite in excess of what is met with in typhus fever except in very severe cases where the rash is usually profuse, and the character and distribution of the dullness over the lungs. A definite dullness at one apex would be strongly in favour of the case being pneumonia. A definite dullness limited to one base or lateral region would point in a similar direction. In typhus any impairment of percussion which exists over the lungs behind is usually bi-lateral, seeing

that it is due to a hypostatic congestion, and is most marked at the extreme bases. Auscultation does not show any such tubularity of the respiratory murmur as one meets with in pneumonia. In those cases of typhus fever which are complicated by pneumonia the signs of consolidation in the lungs do not as a rule make their appearance until the disease is thoroughly established, and in such cases the rash is usually well marked.

A *severe case of enteric fever* may closely resemble typhus. It is true that in the majority of cases a patient suffering from enteric fever comes under observation only after many days of rather indefinite illness, and the appearance of the face is very different from that met with in typhus, the general colour of the skin being pallid and what flush there is confined more or less accurately to the malar regions. The eyes are seldom suffused, and the pupils are usually dilated. The rash of enteric fever, however profuse it may be, is usually composed of definite rose-coloured lenticular spots, which fade on pressure, and do not tend to become "" fixed " as the disease progresses. Diarrhœa in enteric fever is the rule, and the right iliac region is usually somewhat full, pressure over this region educing a certain amount of gurgling. The onset of enteric fever, however, is not always gradual. The patient may be struck down with as great rapidity as in any case of typhus or pneumonia. The pupils may be contracted and not dilated, the eyes may be suffused, and the face exhibit a general congestion, having no resemblance to the malar flush which is usual in enteric. There may be no tumidity or gurgling in the right iliac region, the rash may be definitely "fixed," and darker in colour than is usual. To make the confusion greater, such a case of enteric fever may present signs of great nervous excitement early in the disease, and, splenic enlargement and a certain amount of congestion of the base of the lung being common to both diseases, diagnosis may be a very difficult matter.

It is usual to say that a Widal's reaction will clear up the diagnosis promptly and effectively, but, unfortunately, this is not the case. It is quite common to have the reaction delayed in enteric fever until convalescence is established, especially

if the case be a severe one, and a positive Widal's reaction in small dilutions is quite common in typhus fever. It is true that a positive reaction obtained with high dilutions is probably quite diagnostic of enteric fever, since a positive reaction is obtained in typhus only in comparatively low dilutions, but a negative Widal obtained at such a stage of the illness as is likely to be confused with typhus fever is no evidence, taken by itself, in one direction or the other. A positive Widal, however, is an important addition to evidence in conjunction with other differential points, such as the appearance of definite lenticular spots, which are not "fixed," and evidence of some local lesion in the abdomen. The fact that a negative Widal is so common in enteric fever just at that stage of the disease where differentiation is otherwise difficult, has led one to rely much more strongly upon the isolation of the *bacillus typhosus* from the blood, and where the diagnosis is doubtful such an examination of the blood should always be made.

The odour of typhus may be a considerable aid to the differential diagnosis in such cases.

One is very often forced in cases of this kind to rely upon the history. Cases of enteric fever with sudden onset are very uncommon, and, as a rule, before a case of enteric fever has assumed the facies of typhus with its congested face, suffused eyes and contracted pupils, the disease has lasted for nearly a fortnight. In cases where the history is of no help, one's diagnosis must rest on the development of the case and the occurrence of a crisis about the fourteenth day of illness. Sometimes only a post-mortem examination will clear up the case.

In ordinary *purpura*, fever is very uncommon, the disease is not accompanied by nervous symptoms, and there is a great tendency to bleeding from the mucous surfaces. The spots in true purpura are, as mentioned before, very much larger than the petechiæ of typhus. Occasionally, however, one sees as a result of some *obscure general pyogenic infection*, a febrile illness associated with a purpuric eruption and enlargement of the spleen, which, although not accompanied by any cerebral symptoms, might to the unlearned suggest typhus fever. In such cases, however, the face as a rule shows extreme pallor, and an examination of the blood reveals either a destruction

of all the blood elements or a definite leukæmia, which places the diagnosis beyond question.

Meningitis is another disease which may be confused with typhus, especially if the meningitis be of the *epidemic cerebro-spinal* form. There is often very little or no head retraction in the early days of a case of cerebro-spinal meningitis, and petechiæ are frequently present on the skin. In such cases the petechiæ are larger and less numerous and the patient is more irritable and hyper-sensitive than is the case in typhus, in which the sufferer is usually dull and apathetic. The meningeal cry, also, is not met with in typhus, and squint, ptosis, and inequality of the pupils, which are very characteristic of meningitis, are signs of extreme rarity in typhus. Where real doubt exists as to a case being one of cerebro-spinal meningitis or typhus, a lumbar puncture should be performed, and the characters of the cells and the presence or absence of the *diplococcus intra-cellularis* will clear up the diagnosis.

The *uræmic* state may resemble typhus, in spite of no rash being present, but in such cases the fact that the temperature is normal or sub-normal should readily establish a differentiation.

Treatment.—In the treatment of typhus one of the great essentials is that the patient shall be nursed in an apartment that is large, clean, and particularly well ventilated. It is wise to allow in hospital 3,000 cubic feet of air space for each typhus patient. The ward should be kept at a low temperature, and the patient's bed-clothes should be few and light. The ventilation must be by open windows, so that a free current of fresh air is always in circulation in the ward. In this way risk of infection is greatly minimised, and a constant current of cool air is very grateful to the patients who are suffering from high fever.

The great muscular weakness of the patient and the tendency to cardiac failure to which he is prone, make it necessary, almost more so than in any other acute fever except pneumonia, to avoid any attempt to reduce the temperature by means of anti-pyretic drugs.

Sponging of the surface of the body with tepid water is advisable for patients who are showing a high temperature, say, over 104° F., especially as this treatment not only tends to lower the temperature for a time, but is very comforting to the patient. Any attempt to reduce the fever by the use of cold baths is not to be encouraged, as the extreme prostration of the patient is a distinct contra-indication to any movement beyond turning in bed. It is wise to sponge the back, sacral region and hips with spirit, as this process tends to harden the skin, and prevent the occurrence of pressure sores, which are, however, much less common in typhus than in enteric fever.

On the occurrence of the crisis the patient's bedclothes should be increased to avoid any chance of his being chilled. Shortly after the crisis is complete and the temperature has finally settled, the patient should be removed to a convalescent ward, which ought to be kept at a higher temperature than the acute ward, and the bed-clothes may be increased according to the patient's feelings.

The patient's mouth must be carefully cleansed several times a day, the lips and teeth freed from sordes, and the tongue cleansed and rubbed with some antiseptic preparation, such as a solution of boro-glyceride.

The greatest care must be taken to see that the patient's bladder is emptied frequently in the day, say every four hours. This is particularly necessary in typhus on account of the delirium of the patient and the tendency to over-distention of the bladder, which follows on the great weakness of its walls.

Sleeplessness must be dealt with by suitable hypnotics, and opium is not so useful a drug in typhus as in most of the other acute fevers, seeing that engorgement of the lungs and persistent contraction of the pupils are always a contra-indication to the use of opium, and these two conditions are very frequent in typhus. Sulphonal, in doses of 25 to 30 grs., combined with a small quantity of alcohol, is often found to be of great service, and if there is much tendency to cardiac failure paraldehyde is useful for quieting the patient, and producing sleep. A dose of 90 minims is usually required to have any effect.

It is very necessary in typhus that the patient should be made to sleep, as if sleep is not obtained wild delirium is apt to ensue. No patient should be allowed, if at all possible, to pass more than one sleepless night, and even when first seen a considerable degree of excitement on the part of the patient necessitates the giving of some hypnotic, without waiting to see if natural sleep will come during the night or not. In typhus one can afford to take no risks. When sulphonal or paraldehyde are used as hypnotics they should be repeated at frequent intervals until sleep is produced, or until the amount of the drug given is so large as to warrant the physician staying his hand. The drugs may be alternated with advantage. In some cases all hypnotics will fail, and despite the efforts of the physician the patient will remain sleepless, restless and more or less violently delirious, until death occurs.

The use of *alcohol* in typhus fever is in most cases very necessary, but care must be taken that the drug is given in reasonable quantities, and not in the extravagant doses which obtained during the last generation. It is probable that most young patients, say, under the age of twenty, do better without any alcohol, but it is equally true that the vast majority of patients over thirty require some alcohol during the course of the attack. It is not usually necessary to give it during the first week of the fever, except in small quantities in combination with sulphonal to procure sleep. As the patient enters, however, on the second week of illness, alcohol may be given fairly freely in doses, say, of ℥ii.—℥iv. every two hours. If, after the administration of alcohol, the action of the heart is found to be stronger and not so rapid, and the pulse becomes fuller, stronger, and more regular, while the dry, shrivelled tongue grows moister, and delirium becomes less urgent, the drug is doing good and should be continued. If, on the other hand, the pulse continues to be weak, rapid and irregular, no alteration takes place in the condition of the tongue, and there is no lessening of the delirium, alcohol is doing no good and should be discontinued. In most cases whisky is the best form of alcohol to give, except when there is much diarrhœa, in which case brandy will be found to answer better. A little champagne will sometimes check a tendency to hiccough, especially if given with ice.

While it is common to delay the use of alcohol until the occurrence of definite indications for its administration, it is well, should a majority of cases in an epidemic show a tendency to violent delirium and cardiac failure early in the second week of the disease, to give alcohol early in the fever to anticipate the occurrence of such symptoms rather than to wait for their appearance before dealing with them. It will be found where alcohol is given early in the fever that a small dose, say of ℥ii. every four hours, may make all the difference to the patient's comfort, and may greatly lessen the tendency to delirium and cardiac failure. Even when its administration is begun early in the fever, it will be found necessary to increase the dose as the second week of the disease advances.

It would seem likely that certain cases are saved at the time of the crisis by the use of large quantities of alcohol, and no patient should be allowed to die with a falling temperature and a rising pulse rate without alcohol being pushed perhaps to the extent of ℥i. or ℥ii. in the hour. The time during which such excessive dosage may be necessary is very short, and it is not likely that the physician will run any risk of poisoning his patient when the drug is used in large quantities solely in such an emergency. Those who rabidly oppose the use of alcohol cannot argue with any truth that the administration of this drug to a patient who is unconscious and delirious, and suffering from an acute fever, can possibly induce an alcoholic habit when he recovers consciousness. It is quite another thing when alcohol is used during the convalescence of a disease like typhus, when it is quite unnecessary, and may well lead to the formation of an alcoholic habit in those who are not very strong-minded, and who appreciate the slight exhilaration and increased feeling of well-being which follows on its use.

Where alcohol is apparently doing no good *other stimulants* may be employed. *Ammonium carbonate*, combined with the *spirit of chloroform*, is often of service. *Camphor* is a powerful diffusible stimulant, which is often of great benefit. A very convenient way of administering camphor is by making a 10 per cent. solution of the drug in almond oil,

and using this solution as a hypodermic injection. *Musk* is another stimulant which has had a great vogue in the treatment of those cases of typhus which show a tendency to great prostration and low muttering delirium. It should be given in 5 gr. doses, repeated as required. One great drawback to the administration of musk is the cost of the drug, which is so considerable as to make its use almost impossible in hospital practice, but there is no doubt that in many cases it is an admirable stimulant.

Certain of the *complications* of typhus require *special treatment*. *Bronchitis* and *pulmonary congestion* may be treated by poulticing, dry cupping and the use of stimulating liniments externally, and ammonium carbonate in small doses of 2 or 3 grs. internally. Quinine in doses of 3 to 5 grs. every four hours is often of great service, and digitalis may be used in combination either with quinine or ammonia. Strychnine is an unsatisfactory drug in typhus, as it frequently tends to increase the restlessness of the patient.

If *constipation* is present, enemata or small doses of castor oil may be given, but powerful purgation should be carefully avoided. If there is much *diarrhœa* it may be treated by the restriction of the diet to boiled milk and lime water, and the lower bowel should be washed out by a long-tube enema of sterilised water once a day. An astringent mixture is sometimes of service.

Headache may be relieved by 5 gr. doses of citrate of caffeine. Phenacetin, and similar drugs, should be avoided, on account of their tendency to depress the heart. Frequently changed cold application to the head or Leiter's coils are often of great service in relieving headache and lessening delirium.

If *delirium* is wild the patient must be controlled by wristlets and anklets. Hyoscin has been used hypodermically in these cases, but the results following its use are not particularly encouraging. Chloral is also recommended, but in a disease with such a grave tendency to cardiac failure as typhus it is not a very safe drug. It does, however, appear to lessen the muscular twitching, tremor and almost convulsive movements which are present in many severe cases.

If there is any indication of the occurrence of *convulsions* the patient should be freely purged with calomel and salts, dry cups and poultices should be applied to the loins, and wet cupping is often of service.

Abscesses and *boils* must be treated by ordinary antiseptic methods, and where "*white leg*," or *thrombosis of the femoral veins* occurs, the limb should be elevated and enveloped in cotton wool, and glycerine of belladonna may be applied on strips of lint covered with protective tissue to relieve the pain.

If, during convalescence, any *paresis* of muscles occurs the condition will be found to yield readily to a generous diet, massage, and galvanism.

Parotitis and *bubonic swellings* of the lymphatic glands must be treated by ordinary antiseptic methods.

During the first few days of convalescence the patient should be prevented from assuming the upright position, and should be carefully guarded against chill.

Diet.—During the acute stage of the fever, the patient's diet should be limited to a pint or a pint and a half of milk, a pint of chicken broth, and a pint of barley water, while at the same time he should be encouraged, or indeed forced, to drink large quantities of water. There is no doubt that the drinking of large quantities of water has an excellent effect upon the condition of the patient, particularly as regards the tongue, insomnia and delirium. It is probable that the drinking of large quantities of water assists in the elimination of toxins by increasing diuresis.

About the time of the crisis egg-flip, sweetened with sugar, with a little brandy added to it, is a useful addition to the fluid dietary.

After the crisis is complete it is not well to satisfy the patient's appetite for the first two or three days. Some light farinaceous food may be introduced, with perhaps an occasional egg, but it is well to wait until the tongue is clean and the pulse is settled before giving fish, fowl or mutton. As a rule, some three or four days after the occurrence of the crisis the patient's diet may be rapidly increased until within a week a full diet is taken, regulated largely by the patient's appetite and powers of digestion.

Epidemiology.—Of late years typhus has been practically unknown in England, and is seen but rarely in Scotland. Ireland still shows a tendency in its poorer districts to epidemics of typhus, but even there the frequency of the disease is gradually lessening. Whereas in Glasgow, forty years ago, typhus was a scourge which took as its toll an appreciable percentage of all medical practitioners, it is now quite uncommon to meet with any regularly occurring epidemic of the disease, and when an epidemic does occur it is usually so small as to be quite negligible. Typhus is still found to some considerable extent in Russia; it is seldom seen in other parts of Europe, and is practically unknown in the United States of America.

It is a disease which is definitely connected with dirt and overcrowding, and the improvement of sanitary conditions in our great cities, combined with energetic measures for the isolation of all those suffering from the disease and also of all contacts, have been the means whereby the epidemic prevalence of typhus has been reduced.

Epidemics occur, perhaps, with greater frequency in the colder months of the year, presumably because at this time ventilation of the houses of the poor is apt to be more than usually defective.

No micro-organism has been discovered as the causal agent of typhus, but there is no doubt that some such causal agent does exist.

The striking distance of the infection of typhus is very short, so that in a well-ventilated ward there is very little risk of the disease spreading from patient to patient. It has been usually said that the infection is carried by the emanations from the patient, and it is possible that such may be the case. But, from a study of other diseases whose causal agent is known, it will appear likely that the infection may be present in the blood stream and in discharges, and quite probably is conveyed from patient to patient by fomites, or, which is very probable, by the agency of some intermediary parasite, for instance, the flea. The late Dr. J. B. Russell, of Glasgow, used to say that an outbreak of typhus spread naturally along the side of the street in which the first case had arisen, but

did not tend to cross the street unless some person had visited over the way, and afterwards contracted the disease. Until, however, the causal agent of typhus is definitely discovered, the method of infection must be a matter of pure conjecture. It appears as if the disease were occasionally capable of being conveyed by fomites for some considerable distance. I recollect one small epidemic of typhus in Glasgow which seemed to follow on the arrival to a family resident in the city of a supply of stockings from the Outer Hebrides, where typhus is comparatively common.

It may be taken for granted that a patient who is completely convalescent from typhus has ceased to be infectious.

The *death rate* of typhus may vary in different epidemics between about 6% and 20%. 10% is quite a usual death rate in an ordinary epidemic. In the first five years of life the mortality seems to be most commonly about 5% or 6%; in the second five years of life about 3% or 4%; in the third period of five years about 2%. Thereafter the mortality rate rises steadily with age, until between the ages of thirty and forty the death rate is about 35%; between forty and fifty a little over 40%; between fifty and sixty about 50%, rising to something like 80% in people over seventy. The death rate is higher among men than among women, and this is doubtless connected with the fact that among women chronic alcoholism is much less than among men. Pre-existing disease, privation, dirt, and anything which lessens vitality, are all factors which will tend to raise the mortality rate, which is also influenced to some extent by season, rising to a maximum in late winter and spring, and falling to a minimum with the incoming summer.

Second attacks of typhus are not very common, but do occur. Murchison himself had the fever twice. The second attack may be as severe as the first, or may be distinctly milder.

Home Prophylaxis.—The strict isolation of patients suffering from typhus fever is absolutely essential, and it has been found by experience that efficient isolation is impossible in a patient's house where the disease arises in a community of any size. In small isolated communities, with little or no

hospital accommodation at their disposal, it may still be necessary to deal with the patient at home. In such cases it is necessary to cut off entirely from the community, not only the patient, but all the patient's household. Efficient ventilation and cleanliness must be insisted upon, and at the termination of the case the whole house must be disinfected, and all articles such as bedclothes and clothing, and, indeed, all textile fabrics, should be destroyed.

In towns, however, it is never possible to nurse the patient at home, and the question of home prophylaxis comes very little into any scheme for dealing with this disease.

Public Health Administration.—It is on the early recognition of cases, the strict isolation of patients in hospital, and the equally strict isolation of all contacts during the possible incubation period, combined with the most rigorous methods of disinfection and the enforcement of sanitary cleanliness, that success in dealing with an epidemic of typhus depends; and for the efficient public health administration of the disease it is necessary to have a staff at the disposal of the local authority which is thoroughly acquainted with the disease, and powers at the command of the administration to enforce the isolation of patients and "contacts," and to carry out the most stringent methods of disinfection in those houses in which the disease has occurred. On the removal of a patient to hospital all known "contacts" should be isolated in a reception house, and observed carefully, both night and morning, with regard to general symptoms and the occurrence of any fever by competent practitioners. On the occurrence of suspicious symptoms in any "contact," he should be at once removed to an observation ward, where his health can be studied at frequent intervals, and from which he can be sent on to the typhus wards as soon as it is apparent that he has fallen a victim to the disease.

The disinfection of the house in which a case has occurred should be of the most rigorous description. Bedclothes and all washable wearing apparel should be soaked in some powerful disinfectant and then boiled before being washed. Mattresses may be disinfected by steam, but it is far better to destroy them, as well as any curtains and other textile fabrics

which are difficult of complete disinfection. Books and furniture may be disinfected by a formalin spray, and the whole interior of the house should be washed down with a solution of formalin or bi-chloride of mercury. Walls should be stripped and re-papered, whitewashed surfaces should be re-done, and all painted surfaces must be scraped and re-painted.

On the occurrence of a case of typhus the whole neighbourhood in which the case has occurred demands very careful and scrupulous attention on the part of the sanitary authorities with regard to cleanliness of entries, stairs and back-courts, and the disinfection and removal of all rubbish, and demands also a rigid investigation into the degree of over-crowding which obtains in the district. It is usually found during the investigation of a neighbourhood in which typhus has broken out that many of the houses are so old and badly kept that proper disinfection of them in their existing condition is quite impossible, and in most urban communities the local authority has the power to order the closing, re-building or structural alteration of such buildings, so that they may cease to be a source of danger to the community in which they exist. Considerable hardship may arise in arbitrary action of this kind, but when it is remembered that it is by the rigid application of the measures indicated above that Edinburgh and Glasgow have been practically freed from the incidence of a disease which used to attack many hundreds in each year, and annually cost these cities large sums of money, it will be readily seen that it is better that the interests of a few should suffer for the general good of the community, than that such a state of things should become again possible in our day.

Chapter XXI.

MUMPS.

Synonyms.—Specific parotitis; epidemic parotitis.

German: Zeigenpeter.

French: Les oreillons.

Definition.—An acute infectious disease characterised by inflammatory swelling of the parotid gland.

Incubation.—The incubation period of mumps is very variable, and may be as short as twelve or as long as twenty-six or twenty-seven days. In the majority of cases the incubation period is from seventeen to twenty-one days, but for quarantine purposes it is well to reckon it as four weeks.

Rash.—No rash has been observed which is specific in this disease. Occasionally in children urticarial eruptions are observed, as is common in all generalised infections.

Symptoms of Invasion.—While enlargement of the parotid gland is frequently the first sign of the disease which is manifest, the enlargement is preceded in the majority of cases by two or three days of general malaise, headache, and possibly vomiting with some elevation of temperature. These prodromal symptoms, while usually existing for two or three days before the appearance of the parotid swelling, may show themselves only a few hours before the gland begins to enlarge. Bleeding from the nose, "ear-ache," and some degree of sore throat are also met with among the symptoms of invasion.

Clinical Types.—After a variable period of invasion one or other parotid gland begins to enlarge, and the swelling is first seen just below the ear. The swelling then spreads both upwards and downwards, until, at the end of a day or two, it

invades the greater part of the side of the face and neck. The swelling is extremely tender, there is much aching in the jaw, and any attempt to open the mouth is attended by considerable pain. The gland becomes fully enlarged in about twenty-four to thirty-six hours after the first appearance of the swelling below the ear. In cases where only one gland is affected, the swelling remains without change for a day or two, after reaching its maximum, and then subsides gradually, disappearing completely about the tenth day of illness. More often than not, however, both parotid glands are affected, the second swelling appearing as a rule a few days later than the first. It runs a similar course and is gone, like the first, within ten days of its appearance. In such cases of double parotitis it will be seen that the duration of the illness will be close on a fortnight.

In other cases, not only is the parotid attacked, but the sub-maxillary salivary gland is also affected, and in such cases the swelling may be very large, extending from the front of the ear almost down to the clavicle. Sometimes both parotids and both submaxillary glands are involved. There is usually an interval of a day or two between the involvement of each set of glands, and thus the course of the disease may be prolonged for something like three weeks. In some cases it has been noted that the second parotid gland has become affected only after some weeks have elapsed after the involvement of the first, as if the patient had suffered from a true *relapse*.

Early in the course of the parotid enlargement the opening of Stenson's duct becomes visible as a small red projection from the mucous membrane of the cheek on a level with the second upper molar, and it remains visible until the swelling has disappeared.

The skin over the affected parotid is usually somewhat reddened, although it may be quite pale, and palpation of the swelling shows it to be tense, somewhat elastic and very tender. Movement of the jaw, particularly if both parotids are involved, is difficult and troublesome on account of the pain it produces, and it may be no easy matter to persuade children to take food under these circumstances.

There is almost always a certain degree of stomatitis present in addition to the parotitis, and some swelling and inflammation of the tonsils is very common.

On account of the difficulty of moving the jaw, saliva is apt to collect in the mouth in a troublesome way, but this is not caused by any increase in the salivary flow. In the case of patients who are able to bring themselves to move the jaws during the acute period of the attack, and in most patients as the swelling subsides, dryness of the mouth owing to a defective salivary flow is a common complaint.

So long as the parotid gland is enlarged a certain amount of pyrexia is usual, and in severe cases the fever may rise very high. In some mild cases, however, the disease runs an afebrile course throughout. The fever declines with the subsidence of the glandular swelling, and is, of course, prolonged in those cases where successive groups of glands become involved.

The constitutional disturbance in mumps varies very greatly. In the majority of cases it lessens as the period of invasion ends and the local lesion develops. In many cases, however, the patient suffers from general discomfort, with headache and anorexia, until the swelling of the glands subsides, and perhaps even for some days thereafter.

In certain severe cases the skin over the swelling is so deeply congested as to be almost black.

The parotid swelling gives to the affected side of the face a curious square look, and there may be some puffiness and swelling about the eyelids on the same side as the glandular enlargement. The parotid swelling in almost all cases subsides without suppuration.

Complications.—While the local lesion never gives rise to any dangerous symptoms, certain complications may arise which are of the nature of metastases, and are very troublesome, often leading to serious results.

The most common of these are *orchitis* in the male and *mastitis* and *inflammation of the ovaries* in the female. These complications are not common before the age of puberty, but are sometimes seen before that period. They make

their appearance about a week after the beginning of the parotid enlargement, and are usually ushered in, especially in the case of orchitis, by a recrudescence of the symptoms of invasion, and by a rise of temperature which may be considerable. The constitutional disturbance is in most cases severe when *orchitis* occurs, and the patient's expression is pained and anxious; the face is sometimes pale, and the whole appearance of the patient suggests collapse. The amount of pain complained of in the testicle is very variable. The gland is always swollen and tender, but some patients complain of practically no pain, while in other cases the pain may be excruciating and the tenderness exquisite. The epididymis usually escapes the inflammatory process, but a slight urethral discharge is sometimes present. It is usual for the orchitis to subside in the course of three or four days, certainly within a week. In some cases the second testicle is attacked a few days later. The serious aspect of the orchitis which complicates mumps is that it is frequently followed by atrophy of the testicle, and cases have been known where atrophy of both testicles has followed an attack of double orchitis, with resulting sterility. In certain rare instances orchitis has been noted as the only local manifestation of the infection of mumps.

Mastitis is, in most instances, only a trifling complication, associated with a certain amount of pain and tenderness in the breast, usually subsiding in a few days without having given much trouble. While mastitis is a complication that is usually seen only in the female, it has been known to occur in men and even in boys.

Inflammation of the ovaries is usually expressed by tenderness and a little pain in the ovarian region, but any enlargement of the glands is rarely great enough to be evident on palpation.

Pancreatitis is met with occasionally, and may be relatively frequent as a complication in certain epidemics. In other epidemics it may never be seen. When it does occur the parotid swelling subsides rapidly, vomiting and constipation are present, and there is considerable pain and tenderness in the epigastrium. In some cases the abdominal symptoms

are quite alarming; vomiting is severe, and the vomit may contain blood; pain in the epigastrium is intense, and the patient shows signs of collapse. In a few cases a tender transverse swelling is discovered on palpation of the lower epigastrium.

A rare complication which, when it occurs, usually follows on the occurrence of orchitis is *meningitis*. It would appear that recovery is the rule in such cases, but unpleasant sequelæ have been recorded in a few instances which would lead one to believe that the inflammatory process was not limited to the meninges, but that a *meningo-encephalitis* had existed. Such sequelæ are *unsteadiness in walking, difficulty in articulation, local paralysis of one arm,* and *temporary aphasia* with *agraphia.*

In a few cases the parotid swelling may go on to *suppuration*. In such cases the suppuration is undoubtedly due to a secondary infection of the affected gland by ordinary pyogenic micro-organisms, and not to the specific poison of mumps.

Sequelæ.—The nutrition of the patient is often impaired for some considerable time after the attack of mumps, and complete restoration to health is frequently only attained by persistence in a generous diet, the use of iron and malt, and perhaps a change of air.

Beyond this general impairment in nutrition an attack of mumps is not followed as a rule by any definite sequelæ, but, as rare sequels of the disease, *deafness, facial palsy* and *nephritis* may occur. *Deafness* is limited to one ear and appears shortly after the parotid swelling has subsided. It may be due to an inflammation of the eustachian tube which spreads to the middle ear. In such cases hearing is usually restored by suitable treatment. Another form of deafness which appears early in the course of the disease seems to result from an inflammation of the labyrinth, and may be accompanied by noises in the head and attacks of vertigo and nausea, or even vomiting. In these cases the deafness is practically always permanent.

Facial palsy results probably from a direct extension of inflammation to the sheath of the facial nerve from the affected

parotid. Such a palsy may occur in the second or third week of the disease, and persists as a rule for a month or so. Recovery is practically invariable, although the condition is sometimes a little obstinate.

Nephritis, peripheral neuritis and *inflammation of the optic nerve with subsequent atrophy,* are extremely rare sequelæ, which, however, seem to occur now and again.

Speaking generally, complications and sequelæ of any importance occur only when the original attack of mumps has been severe.

Diagnosis.—When an epidemic of mumps prevails in any district the diagnosis of new cases is not a difficult matter. A parotid swelling appearing suddenly in a patient who has hitherto been quite well, does not occur in any other disease. If, after the occurrence of an inflammation in one parotid, the other becomes affected within a few days, the diagnosis is beyond question.

The parotitis which is the principal lesion in mumps differs from most other inflammations of the parotid gland in that a very slight enlargement of the gland is associated with a difficulty in opening the mouth and pain on mastication out of all proportion to the swelling. This does not occur in any other form of parotid enlargement. The early presence, too, of an inflamed and visible orifice of Stenson's duct is of assistance in diagnosis. It is of importance to remember that in the early stages of an attack of mumps the swelling of the parotid may be very slight, and confined entirely to that portion of the gland immediately below the ear and behind the ramus of the jaw. In mumps, even this slight amount of parotid inflammation is attended by pain on mastication and a considerable degree of tenderness over the slight swelling, which is sufficient in itself to suggest a diagnosis of specific parotitis.

Parotitis occurs, of course, as a complication and sequela of other acute fevers, but only, as a rule, in those cases which are more than usually severe, and there is little likelihood that this type of parotitis, which may be described as symptomatic and not specific, will be confused with a true attack of mumps.

The glandular enlargement, however, which occurs below the ear and about the angle of the jaw in diphtheria may produce a swelling which is superficially not at all unlike the deformity produced in certain cases of mumps, where the enlargement of the parotid gland is almost entirely downwards and not in front of the ear. In such cases, however, there is very rarely any difficulty in opening the mouth or any pain on mastication, and even in mild cases of diphtheria, without much constitutional disturbance in the early days of the disease, an examination of the fauces will make the true nature of the case at once apparent, since it is only in cases of faucial diphtheria that enlargement of the cervical lymphatic glands is seen. Cases of diphtheria of the primary nasal or laryngeal type do not display any enlargement of the cervical lymphatic glands.

Mirchamp has described a test upon which he places some reliance in the diagnosis of mumps from other parotid enlargements, and which he says is successful in establishing a diagnosis even before there is any enlargement of the parotid gland. The test consists in the application of vinegar to the tongue, and Mirchamp states that in cases of mumps a painful reflex secretion of saliva occurs in the gland which is already enlarged, or which is about to be affected. He also states that the reaction may be present also in those cases where there is no enlargement of the parotid, but where orchitis constitutes the only local manifestation of the disease. Unfortunately, the value of this reaction has not been proved by other observers. I have never seen it in my comparatively limited experience of epidemic parotitis, and Claude B. Ker, of Edinburgh, whose experience of this disease is considerable, states that he has always found the reaction negative.

Parotitis may occur in cases of iodism and of lead poisoning, but is very gradual in onset, and is not associated with anything like the same degree of pain and discomfort as in the specific form of the inflammation.

It is well, perhaps, to emphasise the point once more that in an epidemic of mumps the only local expression of the disease may be an inflammation of the testicle, and when epidemic parotitis is known to be prevalent it is always wise

to consider the possibility of a case of orchitis being due to this form of infection, and to make careful enquiry as to whether or not the patient has been in contact with any definite case of mumps.

Treatment.—Although at first mumps may appear to consist only of a mild local affection of the parotid glands, it is well, in view of the possibility of disagreeable complications or metastases, that all patients suffering from mumps should be kept strictly in bed for at least ten days from the first appearance of any parotid swelling. There is no doubt that the occurrence, for instance, of orchitis is greatly favoured by careless handling of the case in the first stages of illness, and in view of the grave results which may follow on the occurrence of an orchitis, the physician should guard against such a possibility by taking every precaution against exposure to chill and over fatigue, even when the early signs of the disease may appear to be trifling. Of course, orchitis may occur even in those who are kept strictly at rest at the beginning of the illness, but careful management in the early days of the attack will go far to prevent the occurrence of such a complication.

The bowels should be freely moved either by small doses of calomel or compound rhubarb powder, the indications for the use of these aperients being a furred tongue and a tendency to constipation or offensive stools.

Since there is always a certain amount of stomatitis present in mumps, the mouth should be kept clean by swabbing or washing with a solution of glycothymoline of a strength of 1 to 5. If the toilet of the mouth is carefully done twice a day it goes far to prevent the occurrence of a spread of the inflammation to the ear by the Eustachian tube or suppuration of the inflamed parotid.

The local discomfort may be relieved by the application of hot bread or linseed poultices to the affected side, and a dressing of "palm oil" spread on a piece of lint and covered with some protective tissue is a very comfortable application.

Where the inflammation of the parotid gland is only moderately severe, the patient should be encouraged to overcome the stiffness of the jaw early in the day by gentle passive and active attempts to open the mouth. The pain and stiffness

in the jaw are, of course, much worse in the morning after the night's rest, during which the jaw has remained practically fixed, and a little effort on the part of the patient in the early morning will often enable him to take food with a fair degree of comfort in the later part of the day. For the sake of nutrition it is well to encourage the patient strongly in all efforts which will increase the mobility of the jaw and lessen the pain during mastication.

Should orchitis occur, the parts should be supported by some form of suspensory bandage, and frequently repeated hot applications should be made to the inflamed gland. Glycerine of belladonna, spread on lint and covered with protective tissue, is a useful application in such cases, and should be alternated with bread or linseed poultices.

Should meningitis occur, the application of leeches to the temples and ice to the head, combined with a free use of strong aperients, will often help to relieve the severe symptoms associated with this complication.

Diet.—During the whole of the period of parotid enlargement the food should be fluid or semi-fluid, and the attendant must encourage the patient to take sufficient nourishment, as in most cases he is reluctant to make the effort of eating on account of the pain and stiffness of the jaw.

As the fever declines, and the swelling of the parotid gland subsides, the diet may be increased, and a full mixed dietary should be resumed as soon as possible.

Epidemiology.—Epidemics of mumps appear with apparently no relation to any particular season of the year. The disease is essentially one which attacks young people, the great majority of those attacked being between five and fifteen years of age.

When epidemics occur, they are usually in connection with schools, and they have frequently arisen in barracks among the younger soldiers.

Various micro-organisms have been described as having been isolated from the parotid and testes, and as being probably the specific causal agent of the disease. Laveran and Catrin have isolated a Gram-negative diplococcus from the parotid, the testes, and the blood, and Teissier and Esmain

have isolated a Gram-negative micrococcus from the saliva and the blood, which they consider as probably identical with the organism described by Laveran and Catrin. It is probable, from the observation of the disease, that it is due to a blood infection by an organism which finds a particularly suitable nidus in the parotid glands, the testes and the ovaries, and it is perhaps better to consider the occurrence of ovarian inflammation and orchitis as not so much true metastases as simply further localisations of the general infection.

The infection is probably spread by the saliva, and it is quite possible that it is transmissable by intermediaries who do not suffer from the disease, and by fomites.

It is well to regard patients who have suffered from mumps as being definitely infectious for at least ten or twelve days after the first occurrence of the parotid swelling, or, in prolonged cases where more than one gland or group of glands have been affected, for a week after the complete subsidence of the last swelling which has appeared.

Mumps is a disease which is quite benign in character, and death is scarcely ever attributable to the disease alone.

Second attacks are extremely rare.

Home Prophylaxis.—Patients suffering from mumps must be isolated carefully from other members of the household, and the attendant in the sick room must be rigid in wearing an overall and in personal cleanliness. Although the infection of mumps is probably short lived, the room which the patient has occupied should be disinfected by sulphur or formalin with considerable care, and afterwards freely ventilated for some days. Bedclothes, etc., which have been in contact with the patient ought to be disinfected by formalin or some carbolic preparation before they are washed, and all coverings of furniture or other textile fabrics should be disinfected carefully, say by a formalin spray or vapour, before being put again into general circulation in the household.

Public Health Administration.—When mumps breaks out in connection with a school, all possible contacts should be carefully observed once or twice a day, in view of the occurrence of new cases. Any unexplained pyrexia, however slight,

is worthy of attention, and complaints of "ear-ache" and stiffness of the jaws should always arouse suspicion. No member of the patient's household should be permitted to attend school for four weeks after he has been isolated, as, although the incubation period is usually very much shorter, cases have been known to occur as late as twenty-seven or twenty-eight days after exposure to infection.

The local authority must be prepared to disinfect at least the sick room of any house in which a case of mumps has developed.

Mumps is not a notifiable disease, and is extremely benign in character, so that no removal to hospital can possibly be insisted upon.

Chapter XXII.

RHEUMATIC FEVER.

Synonyms.—Acute rheumatism.

German: Flussfieber.

French: Le rhumatisme aigu.

Definition.—An acute, specific, non-infectious fever, characterised by inflammation of the serous membranes of joints, and also of the visceral serous membranes, the lesions being commonly multiple.

Incubation.—As this disease is not infectious or contagious, nothing is known as to the period of incubation which intervenes between the time at which the patient is invaded by the poisons of the disease and the appearance of symptoms.

Rash.—No specific rash has been observed in this disease, but there is a distinct tendency to the occurrence of erythemata, both generalised and confined to the neighbourhood of joints, and also of urticarial eruptions of all kinds during the course of the fever.

Clinical Types.—In a typical case of rheumatic fever, the onset of the disease is somewhat gradual. The patient suffers from pain in a joint, and practically at the same time the temperature rises. The ascent of the temperature is usually gradual, and the fever does not attain its maximum, as a rule, until about the end of the first week of illness. The degree of pyrexia in very inconstant. In mild cases the fever may not exceed 100° or 101° F., whereas in severe cases a temperature of 103° or 104° F. is quite common at the end of the first week.

The pulse in the early stages is rapid and ample.

It is very common for patients to suffer from sore throat during the first days, at any rate, of an attack of rheumatic fever, and the throat is seen to be uniformly injected, while there is frequently quite definite enlargement of one or both tonsils.

The tongue is coated at the back and centre with a thick whitish fur, and the edges and tip may be abnormally red.

The joints which are most commonly first affected in a case of acute rheumatism are the knees and the ankles. Pain may be confined at first to only one joint, and is not usually so intense at the beginning of the attack as to make the patient take to bed, although he may suffer considerably from general malaise at this time, and if the temperature is taken it is found to be elevated, sometimes highly febrile. In the course of a day or two, however, the pain in the joint becomes greatly aggravated, and some pain is also felt in other joints. By the end of the first week the joint pain is most commonly very severe, and the joint is not only painful and tender, but considerably swollen. The swelling is due partly to periarticular infiltration, but is also due to the presence of fluid in the joint cavity and in the synovial pouches. In a case even of moderate severity the joint lesion is rarely single, but one joint after another tends to be affected in no regular sequence, pain in one knee being followed by pain and swelling in an ankle, and that again, perhaps, in a shoulder or elbow, the wrists and other joints becoming in many cases also involved. A striking feature of the attack is that as one joint becomes painful, the joint which has previously been the cause of most suffering becomes less painful or even ceases to be painful at all, and that although the swelling may remain.

The face at the beginning of an attack of rheumatic fever is usually pale, but, as the fever increases, it becomes flushed, and the patient exhibits most of the usual signs of pyrexia. In rheumatic fever, however, except in those cases where the temperature rises to definitely hyperpyretic levels, the condition of the skin is in strong contrast to that existing in the other acute fevers where the temperature runs high. It is not harsh and dry, and does not feel burning to the touch.

The patient perspires freely, and in many cases suffers from drenching sweats. Although the skin generally is not hot to the touch, a localised elevation of temperature about the affected joints is usually quite appreciable to the hand.

The pain in the affected joints is of a peculiarly sickening character; the patient suffers continuously, and is quite unable to find relief from pain by any change of position. In a severe case the pain may be quite bearable when the joint is at rest, but any movement of the affected part induces an attack of pain which is in many cases quite excruciating. The joints are for the most part kept in a semi-flexed position, and any attempt to straighten or flex them completely is attended by great suffering. The pain seems to be aggravated as night comes on, and loss of sleep consequent on the suffering is one of the most troublesome features of an attack of rheumatic fever.

The urine is from the outset scanty and high coloured, and usually deposits a considerable amount of urates or uric acid on cooling.

Although sleeplessness is such a common feature of the disease, delirium, even of the mildest kind, is extremely rare, except in those cases who suffer from hyperpyrexia.

The odour of the patient is rather characteristic, the sweat having a curious sour smell of which the patient himself may be quite conscious. The reaction of the sweat is usually, in the earlier stages of the illness, slightly acid.

The duration of the attack is very variable. In an ordinary mild uncomplicated case, in which only a few of the larger joints have been attacked, the acute pain in the joints and the pyrexia subside in about ten days, especially if the salicylates have been used in the treatment of the case, although some stiffness and pain in the joints on movement may remain for weeks afterwards. In most mild cases the convalescence is complete in three or four weeks after the subsidence of the symptoms.

The course of even a mild case, however, may be considerably prolonged by the occurrence of a relapse, which closely resembles the original attack, but is usually milder and of shorter duration. Sometimes the attack is very short, and

it is not uncommon to find that, within twenty-four to forty-eight hours after treatment by salicylates has begun, the pain disappears and the temperature falls to normal. On the other hand, there are many cases of a more severe kind in which the disease endures for many weeks in an acute form, even though no complications appear. In those severe prolonged cases the joint affection is not as a rule confined, as in the minor attacks, to the larger joints, such as the knees, ankles, shoulders, elbows, wrists and hips, but smaller joints are affected as well, the fingers being peculiarly liable to attack. The sterno-clavicular joint, the joints of the toes, the vertebral articulations, and the temporo-maxillary joint may also be affected. Whichever be the joints attacked, the pain is in most cases intense, and the fleeting character of the joint affections is very characteristic.

In the majority of cases, after the pain and fever have passed away, the joints slowly return to their normal condition, and, beyond a little stiffness about the joint itself and some weakness in the muscles which move it, complete restoration to the normal takes place within two or three weeks, or even less. A feeling of stiffness in the joint, which is distinctly exaggerated in damp, chilly weather, may persist in an intermittent way for a year or two after the attack, although ultimately no gross legion of the articular surfaces or the periarticular tissues may be left. In some cases, however, and especially after several attacks of rheumatic fever, a certain amount of permanent deformity and stiffness in the affected joints may result.

There is a *grave type* of acute rheumatism in which, although the joints may not be involved in any great number, the prostration of the patient almost from the outset of the illness is noticeably great, and the fever, although perhaps quite moderate in the early part of the disease, tends to rise steadily as the illness progresses, and is not reduced by any treatment. In such cases the temperature ultimately reaches a very high level, 106° or 107° F. being not uncommon readings. The patient becomes delirious as the temperature rises, and death ensues with a rising temperature, failing pulse, and every sign of an acute toxæmia. Coma is usually present

for some hours before death. There is sometimes a sudden fall of temperature immediately before death, but in many cases the temperature is maintained at a high level for some time after death, and in a few cases there is a distinct post-mortem rise. In other cases hyperpyrexia occurs very suddenly after the patient has been seriously ill for a time, although no indication of an unusually high temperature may have been noticed during an attack of some weeks' duration. In such cases the temperature may suddenly rise within a few hours to hyperpyretic registers, and the patient becomes delirious and dies, probably within forty-eight hours. Death is not the invariable result in those cases of rheumatic fever where hyperpyrexia has resulted, but recovery is exceptional.

The rheumatic fever which is seen in childhood is often extremely atypical, and while the disease, with its multiple joint lesions, high fever, and tendency to the usual complications, is frequently seen in very young people, the primary manifestations of acute rheumatism in children may be very mild and on that account dangerous. One is quite familiar with the occurrence in children of a short illness, with slight sore throat and moderate fever, in which there may be a little pain and stiffness, or at least uneasiness, in certain joints, but which is not accompanied by any visible swelling of the affected joint, or tenderness on manipulation. In association with this mild articular affection is a degree of aching in the muscles or *myalgia*, which may be the principal feature of the attack. The joints themselves in some cases seem to escape entirely, and the manifestations of the disease are confined to myalgia and inflammations of tendon sheaths, notably, perhaps, in connection with the ham-string muscles, and of the periarticular fibrous structures. But if in children the articular manifestations of acute rheumatism and pyrexia are very much less severe than in adults, the disease is rendered more dangerous in childhood than in adult life by the extraordinary frequency with which cardiac complications attend attacks which, in respect of fever and articular manifestations, are so mild as to be almost unrecognisable. It would appear as if in childhood the rheumatic poison, whatever it may be, tended to expend itself upon the heart and

pericardium, leaving the joints largely unaffected, while as age advances, the joint tissues become more vulnerable to the poison, and the heart and pericardium much less easily affected, so that after the age of puberty, or, at any rate, after the age of twenty, articular manifestations tend to be more severe than in childhood, but the occurrence of cardiac complications is much less frequent.

Anæmia is a striking feature of most cases of acute rheumatism. After the first week of illness the patient becomes markedly pallid, the pallor being noticeable not only in the skin, but in the mucous membrane of the conjunctiva, lips and mouth. In association with this anæmia, the pulse is soft and the blood pressure tends to be low. There is a considerable reduction in the number of the red cells, and there may be a slight increase in the number of white cells; the percentage of hæmoglobin is reduced. Where an attack is short, and especially if it is uncomplicated by any serious cardiac or pulmonary lesion, the red cells usually increase rapidly in number during convalescence, but in protracted cases the anæmia may persist for long after all signs of rheumatism have passed away.

Second and even *third attacks* of rheumatic fever are very common, and a patient who has weathered a first attack without any cardiac lesion may develop endocarditis in a later attack. In fact, endocarditis is not so common in first attacks as in second or subsequent attacks.

Complications.—The complications of rheumatic fever arise mainly in connection with the heart and the lungs. Death occurs in uncomplicated cases only when hyperpyrexia occurs as a terminal phase, without any visible gross lesion of the cerebro-spinal system, and it is in the possibility of the occurrence of some of the graver complications that the main danger of an attack of acute rheumatism lies.

While cardiac affections are usually described as complications of rheumatic fever, the description is hardly a correct one. It may be said more truly that they are ordinary and direct manifestations of the disease, and, as certain joints may escape in an attack, and certain others be affected, so in

one attack the myocardium, the endocardium, or the pericardium may be affected, while in another they may escape.

Myocarditis, *endocarditis* and *pericarditis* may occur either singly or together in acute rheumatism.

Of these affections *endocarditis* is by far the most common, and occurs very frequently alone. It is difficult to say accurately when endocarditis appears, since its onset is insidious, and is not associated with any pain, or, if the patient is at rest, with any cardiac disturbance. It is only by frequent and careful auscultation of the heart that the presence of endocarditis can be detected, and then only on the occurrence of a cardiac murmur. The mitral valve is the most commonly affected, and while the aortic valve is sometimes affected alone, an aortic lesion of rheumatic origin is usually found in conjunction with an affection of the mitral valve. The tricuspid valve may also be affected, again usually in conjunction with the mitral, and in children the pulmonic valve is sometimes attacked, although very rarely. It has been said that if no cardiac murmur is detected after careful examination during the first ten days of an attack, it means in a large majority of cases that the endocardium has escaped. In certain cases, however, an acute endocarditis appearing in the course of rheumatic fever does not produce an endocardial murmur for some time. It would appear that in those cases a deformity of the valve sufficient to produce a murmur was not produced during the acute stage of the endocarditis, but occurred only on the contraction of the previously inflamed valve. In certain cases, too, it seems that the detection of a systolic bruit in the mitral area during the acute stage of the attack does not necessarily mean the existence of an endocarditis, since such murmurs have been known to be present in the early stage of an attack of rheumatic fever, but have disappeared as convalescence was established, nor were they again detected, although the patient was under careful medical supervision for many decades thereafter.

Pericarditis is another complication which is both frequent and dangerous. It appears at any time during the course of the fever, and may be present without giving rise to any symptoms referable to the heart, so that only careful

auscultation of the præcordium reveals the presence of any lesion. Pericarditis usually appears in those cases when the joint affection has been extensive and severe. The symptoms which attend its onset are very variable. In some cases the patient suffers from a considerable amount of pain and a sense of oppression in the præcordial region, and the pain is often increased by pressure of the hand or of the stethoscope. The pulse rate is frequently accelerated, even before any friction sound is apparent. The friction sound is most commonly soft and not very loud, and its most frequent situation is towards the base of the heart, quite near the sternal margin. Friction sounds are not always present in cases of rheumatic pericarditis. Clinically, the first sign of the occurrence of pericarditis may be an extension of the præcordial area of dullness. This extension may be general, involving the left, right and upper borders of the præcordial area of dullness, or it may involve the right or the left with the upper border, or may be in an upward direction alone. It is not usual to find an extension only to the left or to the right, and this point is of some importance in a differential diagnosis between a pericarditis without pain and without apparent friction, and a dilatation of one or other side of the heart. The extension of the præcordial dullness is due to effusion into the pericardium. The effusion in most cases is due to "organisable lymph," and may be very large. A mixed effusion of lymph and serum is also frequently met with, but a purely serous effusion is much less common.

The duration of an attack of pericarditis is very variable. In some attacks nothing more is observed than a slight amount of soft friction rub, which appears and disappears within a few days, without any visible extension of the præcordial area of dullness. In other cases where a large effusion occurs the præcordial area of dullness may not resume its normal proportions for many days or even weeks, and after the subsidence of the effusion a certain amount of friction may persist for some time longer.

Pericarditis, when it occurs alone, unaccompanied by endocarditis, is a grave complication, but is not usually fatal, and after an attack the heart may recover completely,

remaining normal to physical examination and giving rise to no trouble during the patient's after-life, even though it is probable from the extent and character of the pericardial effusion that some adhesion between the surfaces of the pericardium is a certain consequence. It would appear that the surfaces of the pericardium may be adherent without giving rise to any after-effects, unless these adhesions are very dense and massive, or unless the parietal pericardium has also become adherent to the pleura or the chest wall.

These remarks apply mainly to the rheumatic pericarditis of adults. In children pericarditis is a very serious condition. During an attack the child is restless, and the pulse is very rapid, although the degree of fever at the time may be quite moderate. As in adults, the pericarditis may proceed with or without a noticeable effusion into the pericardium, but even when all signs and symptoms of the attack have passed, the child is not yet out of danger. The condition tends to recur, and may recur many times. As a rule after each recurrence the præcordial area of dullness remains increased beyond the normal, the heart sounds grow feeble and muffled, and signs of cardiac failure, such as dropsy, dyspnœa and cyanosis, develop. The increase in the size of the præcordial dullness is probably due both to enlargement of the heart itself and to the presence of enormously thickened pericardial layers, which are adherent to each other. Children frequently die as a result of this process within a comparatively short time, and even in those who make a temporary recovery, it is often apparent that the nutrition of the part is seriously interfered with by the pericardial lesion, and the general nutrition of the patient suffers in proportion.

Sometimes the inflammatory process spreads from the pericardium to the pleura and to the mediastinum, and the mediastinum, pleura, and pericardium become adherent and connected by a mass of fibrous tissue. This condition is called "indurative mediastino-pericarditis." When the condition exists, an area of dullness extends upwards in the region of the middle and upper parts of the sternum, and there is evidence of great respiratory and cardiac difficulty. The condition is not common, but has been noted by many

observers. Sometimes the fibrous growth presses upon or constricts the great veins at the base of the heart, and a passive congestion of the liver, ascites, hypostatic congestion of the lungs, cyanosis, shortness of breath and anasarca result.

Myocarditis usually accompanies pericarditis and endocarditis, but there is some clinical evidence to show that an acute myocarditis may occur by itself as the result of the action on the cardiac muscle of the rheumatic poison. Lees has demonstrated how frequently the heart in rheumatism may be enlarged to the right or left, even where there is no evidence at the time of any pericarditis or endocarditis, and it seems only reasonable to suppose that in such cases, where even after the lapse of time no cardiac murmur has become audible which would suggest the presence of a valvular lesion, the dilatation of the heart has been due to a primary affection of the myocardium. An acute primary myocarditis of this kind seems capable of complete resolution.

Pneumonia may occur as a complication of acute rheumatism, and differs considerably in type from acute lobar pneumonia. The amount of consolidation present varies very much in different cases. In some it is quite large, while in others it is very small indeed, and the main lesion may be an extensive and acute congestion of the lower parts of the lung without much definite consolidation. The affection is not usually painful, and although the respiration rate may be considerably increased, cough and expectoration are not as a rule troublesome. The pneumonia, in fact, tends to be rather of a low and incomplete type, and may persist for a long time, and be very slow in resolution. The amount of fever accompanying such an attack may be considerable, and the temperature usually falls not by crisis, but by a rather slow lysis. Pericarditis and pneumonia sometimes occur together, and the combination is a very deadly one.

Pleurisy is sometimes met with, and may go on to effusion. The pleural effusion occasionally becomes purulent.

A simple *bronchial catarrh* sometimes occurs, but is less common than either pneumonia or pleurisy.

Tonsillitis, although usually found preceding an attack of acute rheumatism, may occur during the course of the fever.

Rheumatic nodules, small fibrous swellings which are mostly subcutaneous, but which are also found deeply seated between the muscles, are met with frequently during the course of rheumatic fever, particularly in children. There seems little doubt that these nodules appear in children in association with endocarditis and pericarditis, but they are sometimes seen even in children in cases where no cardiac lesion exists. In association with endocarditis they indicate a grave condition, and adversely influence prognosis. In adults, however, their occurrence seems to have no particular bearing on prognosis, and they have not been specially noticed in those cases which develop a cardiac lesion. They are found in the scalp, behind the ears, at the back of the neck, on the back, the gluteal region, the wrists, ankles, and about the knees. They are painful, and very often distinctly tender on pressure. They are not very sharply defined, and are often so small as to be only discoverable on careful examination. Sometimes, however, they are of considerable size, about as large as a hazel nut or an almond. These fibrous nodules persist in many cases for only a few days, but in some cases they are still evident all through the period of convalescence, and may give rise to considerable discomfort and pain.

Erythema nodosum is sometimes seen even during the acute stage of the fever.

Diagnosis.—Except in young children, and in mild attacks where the joint affection is single, the diagnosis of acute rheumatic fever presents, as a rule, but little difficulty. In a typical case the gradual onset of the attack, the multiple and fleeting character of the joint lesions, the condition of the skin, the profuse sweating, and the generally pallid face, go to form a picture that is not easily mistaken for anything else.

In young children, however, the joint affections being so slight as almost to escape notice, the general aching of

muscles and slight fever may be attributed entirely to the inflammation of the tonsils, which is so often present. Where the joint lesion is single, the condition is often considered to be traumatic, even though no definite injury has been known, particularly as such a condition usually occurs in children of school age and in adolescents, who are, by nature of their amusements, specially liable to trauma.

There are three conditions which may very closely resemble a case of true rheumatic fever, namely, *a certain type of multiple arthritis*, *osteomyelitis*, and a *pyæmia* which arises without any very apparent or definite superficial lesion.

One sees occasionally a patient sent to hospital as suffering from acute rheumatism where the real lesion is an *acute osteomyelitis* of one of the long bones, such as the femur or the tibia. In such conditions there is very often considerable swelling of the knee or the ankle, or some other joint, and the skin in the neighbourhood of the joint is frequently reddened, and there is also swelling of the periarticular tissues. The pain and tenderness are scarcely so acute as in rheumatic fever, and the swelling of the limb is usually quite definitely œdematous, and is not confined to the neighbourhood of the joint, but extends up the limb. The definitely single character of the lesion, combined with constitutional symptoms which are usually severe and a temperature which is commonly of the hectic type, serves to make the differentiation of such a condition a comparatively easy matter.

In the case, however, of *certain types of multiple arthritis* the differentiation from acute rheumatism is not always easy. A definite history of gonorrhœa or the discovery of the gonococcus in the urine of an obstinately uncommunicative person, often betrays the origin of the attack. But apart from any specific form of arthritis there are certain cases of multiple arthritis which are not acute rheumatism, but may be very easily mistaken for it. Particularly in women, and more especially among women who have been weakened by child-birth and certain of its accidental after-effects, a multiple osteo-arthritis may begin by acute swelling with pain and redness of certain joints, accompanied by some

fever. On the first occurrence of such an attack the diagnosis of acute rheumatism may be quite justifiably made, and it is only on the occurrence of subsequent attacks with resulting typical deformity that it becomes apparent that the original diagnosis was wrong. The fact of such a case being associated with a definite focus of suppuration, like an endometritis or pyorrhœa alveolaris, sometimes helps to clear up the diagnosis, especially if on the removal of such suppurative foci the attacks cease. The fever in such cases is usually moderate, and the joint lesion is out of all proportion to the slight amount of constitutional disturbance. The fact that a case which closely resembles a typical attack of acute rheumatism does not in any way yield to treatment by the salicylates should always arouse the suspicion that it is really an early manifestation of a multiple osteo-arthritis.

In *pyæmia of obscure origin* the joint affections may be multiple, but the pain and swelling in the affected joints show none of the fleeting characters which are so typical of the lesions in rheumatic fever. The joint, once affected, remains swollen, reddened, painful and tender, while a hectic type of fever, accompanied by frequent rigors, should make it quite apparent after a short period of observation that the disease is something other than acute rheumatism. Rigors, in the case of rheumatic fever, are of the rarest occurrence, and the fever is practically never of a hectic type.

The early stages of an *acute ulcerative endocarditis* may closely resemble an attack of rheumatic fever, more particularly as a large number of those patients who suffer from an acute ulcerative endocarditis have previously been the victims of acute rheumatism. Again, however, the hectic type of the fever helps one to a differential diagnosis, and the spleen in such cases is often enlarged as the result of repeated embolism. Albumin and blood are frequently met with in the urine of such patients, also secondary to the occurrence of embolism, and, although a certain amount of pain and swelling in joints is not uncommon in the course of ulcerative endocarditis, the course of the disease seldom leaves the diagnosis long in question.

A first attack of *gout* in a young subject, especially if it occurs in a country where gout is not common, is frequently mistaken for acute rheumatism, but in such a case the absence of fever, the presence of gastro-intestinal symptoms, a careful study of the family history, and the absence of any cardiac lesion, are usually sufficient to clear up the diagnosis.

Treatment.—All patients suffering from rheumatic fever must be kept in bed and absolutely at rest. It is of the utmost importance, in view of the possible occurrence of cardiac lesions, that, where there is the slightest suspicion of a patient suffering from rheumatic fever, he should be kept away from all danger of surface chill and should not be permitted to exert himself at all. Once a patient is in bed, he should not be allowed to get up for any purpose.

The affected joints should be wrapped in cotton wool, kept in place by a light dumette or flannel bandage. The patient's clothing should be of flannel, and of such a construction as to be easy of change, disturbing the position of the patient as little as possible. This is of importance, as, on account of the excessive perspiration, frequent change of the patient's clothing must be made.

Various local applications to the affected joints have been employed, such as blisters, cold compresses, and ice packs, and the injection of a solution of carbolic acid into the joint has been recommended by some. A form of surgical treatment which has been urged by a few, is the making of an incision by the side of the affected joint immediately on the occurrence of the pain and swelling. All local applications, however, seem to have little effect on the course of the illness, and for the relief of pain the application of cotton wool and flannel, or a compress medicated with glycerine and belladonna, usually meets the needs of the case, and mischievous local interference is to be strongly deprecated.

The two forms of general treatment which have had the greatest vogue in our own time are the *alkaline treatment* and treatment by the *salicylates*.

The *alkaline treatment* consists in the giving of large doses of the salts of potash at frequent intervals until the fever subsides and for some time thereafter. This form of

treatment seems to have little effect on pain, and when it is employed, pain must be relieved by the hypodermic injection of morphine. Morphine is, as a rule, well tolerated by such patients, especially if there be no pulmonary lesion, since one of the effects of the alkaline treatment is to induce a copious diuresis, which encourages the elimination of the drug. One of the great advantages of the alkaline treatment is that it exerts no unfavourable influence on the heart; in fact, its gently depressing action on that organ rather discourages than favours the occurrence of endocarditis and pericarditis.

At the present day the favourite treatment for acute rheumatism is by the *salicylates*, particularly the salicylate of soda. Salicin and salicylic acid had at one time a considerable vogue, but their effect on the stomach was not pleasant, and they were soon replaced in this country by salicylate of soda. Many observers have noted bad results as following on the employment of the salicylates, but it would seem as if certain of these bad results were due to impurities in the drug, and certain others to excessive dosage and too prolonged administration. The efficacy of salicylate of soda seems to be increased if it is given in combination with the bi-carbonate of soda or the bi-carbonate of potash. It is usual to begin with a dose of 10 to 20 grs. of sodium salicylate, combined with equal quantities of bi-carbonate of soda or potash, repeating this dose every two hours until pain is relieved and fever is lessened, or until slight ringing in the ears and a tendency on the part of the patient to wander indicate that the limits of toleration are being reached. The quantity of the drug should be reduced as quickly as possible, and as pain and swelling of the joints lessen, the frequency of the dose should be reduced so that the drug is given only every four hours. After the pain and fever have gone, the drug may be given twice daily for some days and then discontinued. The occurrence of a pericardial or endocardial lesion is by some taken as an indication that the use of the salicylates should be stopped, but if, even in association with these complications, the heart rate is not excessive and the blood pressure is kept up to a fairly average height, a modification of the dose is usually sufficient.

While the salicylates are being given it is well to observe the behaviour of the pulse very carefully. If the pulse rate tends to increase out of proportion to the temperature, and if the blood pressure is diminished, the dosage should be reduced, even though there is no buzzing in the ears with a tendency to delirium, or any evidence of a cardiac lesion.

Similarly, during convalescence, while it is well to keep up the action of the salicylates for, say, a week or ten days at least after the subsidence of the fever, the dose must be regulated by an equally careful consideration of the pulse and the cardiac strength.

If some stiffness in the joints remains after the fever has subsided, it is good practice to give the patient each morning before breakfast 30 to 60 grs. of the citrate of potash in a good draught of water. This may be continued for a week or two after the treatment by the salicylates has been stopped.

In many cases one of the most troublesome features of a case of rheumatic fever during convalescence is a continuation, and sometimes an exaggeration, of the anæmia which has been present during the febrile period of the disease. When anæmia persists in convalescence an examination of the blood shows as a rule a different picture from that usually obtained during the acute period of the attack. The number of red cells may return practically to normal and there may be no increase of white cells, but the main feature of the anæmia is a persistent diminution in the quantity of hæmoglobin. The anæmia thus assumes a definitely chlorotic type. When this occurs the patient should be put upon steady doses of iron, combined perhaps with a little arsenic. Although the patient is taking iron there is no reason to intermit the doses of citrate of potash which he may be getting at the time. Patients who are suffering from this chlorotic type of anæmia during convalescence are often extremely intolerant of iron, and even the scale preparations may give rise to some gastric disturbance. A preparation which is well tolerated by many patients who are refractory to other salts of iron is the algide, which is sold

under the name of "Algiron." This preparation may be useful in cases which have shown a tendency to intolerance of the drug. It is not wise to administer iron during the acute stage of the fever.

Constipation is the rule in rheumatic fever, and if the bowels are constipated and the tongue coated, a moderate dose of calomel, followed by some sodium sulphate or magnesium sulphate in hot water, should be given. Instead of calomel, a pill containing pil. hydrag. 2 grs., pil. colocinth et hyoscyami. 3 grs., and extr. belladonnæ, ½ gr., may be given. It is not wise to push the action of mercurials in acute rheumatism. One free purge at the beginning of treatment by the salicylates is usually sufficient, and if the bowels tend to be constipated thereafter, some more simple aperient may be used.

The fever in acute rheumatism is rarely so high as to call for any treatment other than tepid sponging of the body and limbs, but when *hyperpyrexia* occurs some special form of treatment is necessary. On no account must antipyretic drugs be used, but ice compresses, ice packs, and rubbing the body with blocks of ice may be of considerable service if the fever has reached dangerous heights. Perhaps the best method of dealing with hyperpyrexia in rheumatic fever is to employ the cold bath. The temperature of the bath before the patient is put into it should be about 65° F., and the water may be kept cool by the introduction of ice, as it becomes heated by the patient, so that the bath is kept steadily at a temperature of about 60° F. The patient should remain in the bath until his temperature has fallen some 3° or 4° F., but if, even after the temperature has fallen only slightly, the patient shows a tendency to shiver or to become at all exhausted, he should be immediately taken out of the bath and put back to bed. The number and frequency of the baths must be regulated by the degree of persistence of the hyperpyrexia. In many cases the cold bath is followed by a tendency to collapse, and on the slightest suggestion of collapse stimulants should be administered freely, and if the extremities remain cold and any cyanosis appears, hot bottles should be applied to the feet and hot cloths over the

præcordium. The possibility of collapse occurring in connection with the cold bath treatment makes it unwise to treat anyone in this way who is suffering from pericarditis, endocarditis or pneumonia. It is true that many cases complicated by a cardiac or pulmonary lesion stand the cold bath treatment well, but, seeing that one has little indication beforehand as to what patient is likely to show a tendency to collapse under this treatment, it is erring on the safe side to avoid treating in this way all patients who are weighted with a pulmonary or cardiac complication. One must not, however, be too dogmatic on this point, since the actual danger of hyperpyrexia may be, in such cases, greater than any possible danger connected with the cold bath treatment.

Endocarditis calls for no special treatment except prolongation of absolute rest beyond the limit common in uncomplicated cases, save that in all probability the dose of the salicylates must be modified earlier than usual.

The treatment of *pericarditis* similarly calls for prolonged absolute rest, and possibly a reduction in the doses of the salicylates. Beyond this all treatment must be symptomatic, and directed towards the relief of discomfort, præcordial oppression and pain. The application of leeches or a blister to the præcordium is often of great service in the relief of pain, but these extremer measures need not be resorted to until the application of heat, combined with the glycerine of belladonna, has been found to bring no relief. Some patients are relieved by the application of ice to the præcordium, but others seem to be fretted and rendered uncomfortable by any cold applications. If the patient is restless and suffers from dyspnœa, a little opium or morphine may be given with benefit.

Pneumonia, *pleurisy* and *bronchitis* may call for special treatment along the lines usually adopted in these diseases.

Tonsillitis requires no treatment beyond the administration of the salicylates, and attention to the cleanliness of the throat and mouth.

The treatment of *rheumatic nodules* depends very much upon how painful they are and how long they tend to persist

after the acuter stage has passed. If in the acute stage of the fever they are associated with much pain, a dressing, composed of an ointment containing ℥iii. of methyl salicylate to ℥i. of lanoline spread on a piece of lint and covered with protective tissue, will often prove very efficacious. Where, however, at this stage of the illness they are not very painful, no special treatment is required. As they often persist in a somewhat chronic form after the attack of acute rheumatism has passed away, and as under these circumstances they are apt to cause annoyance by being tender on pressure and producing a certain amount of stiffness and limitation of movement in certain parts, they sometimes require treatment directed definitely towards their removal. Where the rheumatic nodules tend to persist in this chronic way small doses of iodide of potash, say 3 to 5 grs., may be given thrice daily, and massage should be used to assist in the dissipation of the nodules. Where they are superficial, the massage does not usually need to be severe, and it is better to treat such cases by rubbing gently into the affected areas some preparation like iodex ointment twice in the day. If the nodules are deeply seated, however, they are best treated locally by rather severe massage.

Diet.—During the febrile stage of the illness the diet must be fluid, and should consist of one or two pints of milk, a pint of barley water, and some chicken broth. Chicken broth and other soups have been condemned in rheumatic fever, especially at a time when the disease was supposed to be due primarily to an acid state of the blood, on account of the fact that they are rich in purin bodies, but there is very little evidence to show that, in any disease in which urates and uric acid are precipitated in the urine, the introduction of a certain quantity of food containing abundance of purin bodies has any influence on the appearance of urates and uric acid in the urine, except when the food containing the purins is of such a kind as to give rise to a large amount of putrefaction in the intestines. The advantage of giving some chicken broth or some other well diluted clear soup during an attack of fever is that it seems to stimulate secretion in the stomach, to take the place, in other words, of that

psychic stimulus to digestion which is present in the healthy person, but which is always absent in the patient who is suffering from fever.

The patient should be encouraged to drink freely either of plain water, lemonade, or imperial drink. Patients who are subject to acute rheumatism are usually very thirsty, and no advantage is to be gained by keeping them uncomfortable by limiting fluids in their dietary.

After the fever has subsided, carbohydrates may be added to the diet, and after a week or so fish and a little chicken may be introduced, but one has to be cautious in resuming a full diet, because for some time the patient may be rather intolerant of meat.

Bacteriology. —The bacteriology of rheumatic fever is still doubtful. There seems every reason to believe that it is a definite disease, and also that it is caused by some specific infective agent, but it is not yet definitely established as to what this infective agent is, where it comes from, or how it is introduced into the body. Various micro-organisms have been described as having been isolated from the joints, from the blood both during life and after death, and from the heart lesion. Examinations of the blood made during life have for the most part been negative. In some cases staphylococci, streptococci and diplococci have been found. On examination of the heart's blood after death, more positive results have been obtained, and organisms have been isolated besides the ordinary pyogenic cocci, of which the most important have been the *bacillus of Achalme*, the *micrococcus rheumaticus* of Beaton and Walker, and the *diplococcus* described by Triboulet, Poynton and Paine. It is probable that the two latter are identical, and at the present moment both organisms are spoken of as the *diplococcus rheumaticus*. Achalme's bacillus is probably identical with the bacillus enteriditis sporogenes of Klein, and it is quite possible that its presence in the blood stream is the result of an invasion at the time of death or immediately afterwards.

None of these organisms are found constantly in cases of rheumatic fever, and, although when injected into animals they produce a multiple arthritis, there are many organisms

derived from sources other than rheumatic fever which, when injected into animals, will also produce a multiple arthritis, such as various strains of streptococci and cocci.

It seems, therefore, that the specific organism of acute rheumatism has not yet been discovered, and that the true etiology of the disease is still unknown, although the disease is probably a definite entity.

Climatology.—Rheumatic fever is met with all over the world, but it is specially common in temperate climates. It is said by many writers that the United Kingdom, and especially England, is peculiarly liable to the occurrence of rheumatic fever, and it is probable that the disease is encouraged by chill and humidity of climate. In London the autumn seems to be the season in which most people are attacked by rheumatic fever, but the seasonal incidence of the disease varies considerably in different parts of the country, and while in many districts the seasonal variation is fairly constant, there is considerable difference between one place and another as regards the season of greatest prevalence.

Chapter XXIII.

YELLOW FEVER.

Synonyms.—Black vomit; typhus icterodes.

German: Gelbfieber.

French: Fièvre jaune.

Definition.— An acute specific infectious disease characterised by an initial stage of continued fever, lasting for two or three days, followed by a remission which may lead to convalescence, or which may result in an adynamic condition, which is accompanied by "black vomit," albuminuria, jaundice, suppression of urine, and profound nervous disturbance.

Incubation. — The incubation period of yellow fever is usually about four or five days, but may be as short as twenty-four hours and as long perhaps as twelve or thirteen days. Incubation periods of longer duration have been noted, and it is a matter of common observation that a period of something like a fortnight or longer elapses between the appearance of a patient suffering from yellow fever in any district where the disease is not endemic, and the occurrence of the first secondary case. The reason for this apparently longer period of incubation is to be found in the study of the behaviour of the virus in the infected mosquito, which must be, in the vast majority of cases, the carrier of the infection.

Rash. — Eruptions of various kinds appear in different cases of yellow fever, the eruptions being usually petechial, erythematous or papular, but none of them can be said to be diagnostic of the disease. The eruption which is most characteristic of yellow fever is an erythematous condition, with much congestion, of the scrotum or the vulva, which

appears in a certain number of cases, and the occurrence of which is said by some to be pathognomonic.

Period of Invasion.—The period of invasion of yellow fever is usually very short; in fact, the disease usually attacks a patient without any previous warning. The patient is seized with chill, which sometimes only amounts to a slight feeling of cold, but which in many cases is accompanied by repeated rigors of moderate severity, alternating with periods of heat and flushing. This period of invasion, which lasts, as a rule, from two to twelve hours, and the severity of which is usually commensurate with the severity of the subsequent attack, is associated with frontal headache, pain in the eyes, and severe pain in the lumbar region and legs. The temperature rises, and the patient is usually very pale. In some cases the acute period of invasion is preceded by a few days of general malaise, loss of appetite, headache, giddiness, and constipation.

Clinical Types.—As the feeling of chill passes off, the patient's face becomes red and swollen-looking, the eyes are injected and watery, the headache increases, the pain in the legs grows more severe, and is felt particularly in the calves, knees and ankles. The patient is restless and distressed, but the mind is usually unclouded. There may be perhaps a little wandering at night, but active delirium is uncommon. The temperature rises rapidly with the onset of the disease, usually attaining its maximum within twenty-four hours of the first appearance of definite symptoms of invasion, and remains high until somewhere about the third day. The respiration is rapid and laboured; the pulse is rapid, usually somewhere between 100 and 120, and, during this period of initial fever, full and strong. The patient during this time is usually constipated, but sometimes there is considerable diarrhœa. Pain in the epigastrium, accompanied by vomiting of a clear acid fluid, is fairly common. At times the epigastric discomfort may not amount to pain, but may be rather of the nature of an oppression. The tongue becomes coated with a white fur on the dorsum, but is usually very red at the tip and edges. It is not flabby and swollen, as is so often the case in malaria, but is, in most instances, small and pointed.

This appearance of the tongue is so frequently present as to constitute an aid to diagnosis, especially between yellow fever and malaria. The urine is scanty and often contains a slight amount of albumin by the second day of illness, and the quantity of urea is greatly diminished.

Somewhere about the third day the temperature and pulse fall; headache, pain in the limbs, and epigastric discomfort grow less and may disappear; the flushed swollen appearance of the face is changed, giving place to pallor, and in some cases to a sunken appearance. At the same time the injection of the eyes subsides, and for the first time the sclerotics and skin generally begin to assume the yellowish tint which is so characteristic of the disease. After this fall of temperature, the second stage of the disease is entered upon, which has been called "the period of calm." In mild cases the disease ends at this stage, the temperature quietly subsides to normal, appetite returns, the urine increases in quantity, and albumin disappears. In severe cases, however, the attack does not terminate in this way, and, although the symptoms are less acute, the patient is not free from discomfort during the "period of calm." After a period which varies from a few hours to a day or two the gastric symptoms become aggravated, and the patient is troubled by frequent vomiting, either of a clear fluid mixed with small black particles, or a black fluid which deposits a coffee-ground sediment on standing. At the same time, the fever may rise higher while the pulse grows very weak and the patient suffers from uneasiness in the præcordial region. The face is sunken and expressive of collapse; the skin becomes more yellow, and the tint may, indeed, deepen to a dark brown. Hæmorrhages occur from the gums; the tongue is dry and brown; petechiæ appear in the skin, and sometimes gangrenous areas form on the limbs and on the scrotum. The mind may remain unclouded, but more commonly the patient is dull and listless, and even sinks, now and again, into a semi-comatose state. Delirium of an active kind is sometimes present. Hiccough is common, and subsultus tendinum is often seen. The patient is troubled with frequent cold sweats, and may die either quietly from sheer asthenia, usually

in a comatose condition, or may suffer from violent convulsions just before death. Vomiting of black material may appear late in the stage of initial fever, becoming less during the period of calm, only to reappear with increased violence during the secondary period of fever or "period of reaction." The early appearance of black vomit is a very ominous sign.

While the majority of patients who pass through the period of calm into the period of reaction die, the occurrence of a period of reaction does not necessarily mean that the case will terminate fatally. In a certain number of cases, the temperature begins to subside a day or two after the period of reaction sets in, the gastric symptoms lessen, and the patient slowly recovers. Such cases, however, form a comparatively small minority. During the period of reaction the temperature tends to be somewhat intermittent in character, and is in most cases quite definitely febrile. As death approaches, however, the temperature tends to be low, and in some cases the period of reaction is characterised from the beginning by a temperature which is normal or sub-normal. Such a temperature almost certainly indicates a fatal termination for the case.

In very severe cases, in which black vomiting appears early, the patient may die two or three days after the onset of the attack before any period of calm sets in, and in these cases the temperature usually runs high until the end, and may, indeed, show a very pronounced ante-mortem rise.

There are other extremely grave forms of the disease, in which certain groups of symptoms obtrude themselves which are not common in the usual course of the illness. In some, the patient is suddenly struck down by severe giddiness, followed by coma and convulsions; the pulse is weak from the beginning, and speedily becomes fluttering and irregular; the skin is cold, the pupils are widely dilated, and the patient usually dies, comatose, after a few days' illness. In others, the disease takes on an algid form, in which prostration appears early; the features are sunken, and the surface of the body is extremely cold; the axillary temperature is markedly sub-normal; the pulse is small and "running," and in

many of these cases petechiæ are very numerous. In such cases there is seldom much yellowness of the skin, and any yellow colouration which may appear is usually limited to the conjunctiva. A third type of pernicious case is that in which the symptoms are choleraic in character, and the patient suffers from early collapse, violent vomiting and extreme purging. The skin is clammy and moist, and petechiæ are numerous. Death usually occurs in such cases in the course of a few days, the patient being profoundly collapsed.

The pulse in a typical case of yellow fever is rapid, full and bounding during the stage of the initial fever, but becomes slow and soft during the period of calm and the stage of reaction. Even in those cases where, during the period of calm, the temperature falls to normal and convalescence is thereafter quickly established, the pulse may fall as low as 50, and be very soft. In those cases where a period of reaction sets in after the period of calm, the pulse remains slow and weak, and may fall as low as 40. As death approaches, the pulse is irregular, and sometimes almost imperceptible.

During the period of initial fever the blood pressure remains fairly normal, but it tends to fall markedly during the periods of calm and reaction.

Complications.— The secondary fever of the period of reaction may be prolonged for many days or even weeks, on account of the occurrence of certain complications, of which the most common are abscesses, boils, bubonic swellings of the lymphatic glands, parotitis and hepatitis. These complications occur with very variable frequency, and are more common in some epidemics than in others. They are all of unpleasant significance.

Diagnosis.—A well-marked case of yellow fever, characterised as it is by a single febrile paroxysm, congestion of the face, injection of the eyes, severe pain in the back, albuminous urine, vomiting, first of clear fluid and afterwards of black material, yellowish tinting of the skin and sclerotics, and the occurrence of petechiæ, is not likely to be mistaken for anything else.

In the early stages of the disease, however, before the development of the really characteristic symptoms, there is nothing in the nature of the onset to make a diagnosis certain, and in the milder forms of the disease the characteristic symptoms may never develop completely, and the attack may consist entirely of a few days' fever, accompanied by pain in the back, vomiting, and a certain amount of flushing of the face. In such mild cases the fever terminates almost by crisis at the end of a day or two, and the patient may never show any icteric tinting of the skin, black vomit, or petechiæ.

The locality in which a suspicious case occurs must influence the opinion of the physician. A case which would give rise to no suspicion in northern latitudes would be rightly suspect in those regions where yellow fever is known to prevail. Indeed, any acute attack of fever in districts where yellow fever is endemic or apt to be epidemic should be carefully observed, especially taking into account the fact that yellow fever is peculiarly apt to attack new-comers to the districts in which it is prevalent.

The diseases which are most likely to be confused with yellow fever are the *bilious remittent type of malaria*, *blackwater fever*, and *relapsing fever*.

The *bilious remittent type of malaria* is, like yellow fever, common in new-comers to a malarious district, but the vomiting in this type of malaria is much more definitely bilious in character than in yellow fever, while albumin in the urine is very rarely seen. In bilious remittent malaria, too, tenderness in the splenic region is present from the beginning, and enlargement of the spleen is apparent as a rule a few days after the onset of the illness. The discovery of the malarial parasite in the blood, and the presence of pigmented leukocytes, make the diagnosis sure.

In *blackwater fever*, although vomiting is quite common, the enormous quantity of hæmoglobin in the urine and a relative increase of large mononuclear leukocytes containing pigment serve to distinguish this disease from yellow fever, and it is to be remembered also that blackwater fever never attacks new-comers to a malarious district, but is a disease

which is found only among those who have spent a considerable time in tropical or sub-tropical regions.

Relapsing fever is often accompanied by jaundice, severe pain in the back and vomiting, and the vomited material may be in some cases black; but in relapsing fever albuminuria is not common, and the spleen is most usually enlarged. Examination of the blood will help to clear up the differential diagnosis. A leukocytosis is always present, with a distinct relative increase of polymorphs, while the discovery of the Spirillum Obermeieri would place the diagnosis beyond question.

No specific organism has as yet been discovered as the cause of yellow fever, so that no positive evidence in support of diagnosis can be obtained from examination of the blood of patients who are suspected to be suffering from this disease. There is no doubt, however, that an organism of some kind capable of infecting mosquitoes exists in the blood stream, but experiment has shown that this organism must be extremely small and beyond the power of the microscope to detect, since blood which has been filtered through the coarser bougies of a Chamberland filter is capable of infecting mosquitoes, while blood filtered through the finer bougies is not.

Treatment.—When a patient has been found to be suffering from yellow fever he should at once be removed as far as possible from the infected area, and put to bed. A hot mustard foot-bath should be given, and if he is seen on the first or second day of illness, a purgative may be administered. With many physicians, castor oil is the favourite purgative at this stage, but to be of any effect it must be given in large doses of ℥ii. to ℥iii. The disadvantage of castor oil is that in many people it induces a considerable degree of nausea, and on this account many prefer to employ calomel, giving small repeated doses until 5 or 6 grs. have been given, following up the calomel by a draught of magnesium sulphate, and, in the milder cases, giving some fluid magnesia each day thereafter. It is better, for the most part, to give a purgative only once, and that in the early days of illness, seeing that gastro-intestinal irritability may be greatly increased by the injudicious use of aperient drugs.

In mild cases the foot-bath and the purgative will supply all the treatment necessary. In more severe cases the mustard foot-bath may be repeated more than once.

Various drugs have been employed for the reduction of temperature, but if they are to be used at all they must be used only in the early stages of the disease, seeing that the great danger in yellow fever is profound and increasing cardiac weakness. Quinine seems to do no good, and antipyrin is a dangerous drug to use in diseases where cardiac depression is so profound. A simple saline mixture, containing acetate of ammonium and spirit of nitrous ether, is perhaps the safest means to employ. Some physicians add to this mixture infusion of jaborandi and tincture of aconite, and, in cases where the skin is very dry, the urine scanty, and lumbar pain severe, this combination seems to be of service. For the mere reduction of temperature it is better, in yellow fever as in all other acute fevers, to rely upon sponging and other cold applications to the skin rather than to any drugs which have a powerful anti-pyretic effect.

Vomiting may be relieved somewhat by the application of mustard leaves to the epigastrium, and small quantities of iced champagne or chips of ice are sometimes helpful.

If there are indications of collapse small doses of brandy, frequently repeated, may help the patient during the emergency, but if there is the slightest indication that alcohol increases the gastric irritability it must be stopped at once.

Sternberg gives alkalis freely all through the attack, giving the following combination:—150 grs. of sodium bi-carbonate and $\frac{1}{3}$ gr. of mercury perchloride in a quart of water, of which the patient takes ℥iss. every hour. Manson quotes Sternberg's results after the use of this form of treatment—301 whites were treated in this way, and only 7.3 per cent. died, while 72 blacks all recovered.

Morphia is a dangerous drug to use in yellow fever.

For the treatment of black vomit perchloride of iron, acetate of lead and the injection of ergotin have been recommended, but the symptom seems to be refractory in most cases to all form of treatment. Where the gastric irritability is extreme and the urine is scanty, fluid should be supplied

to the patient in the form of rectal injections of normal saline solution.

When heart failure is marked, the hypodermic injection of ether, strychnine and digitalis should be employed.

Diet.—During the period of initial fever the patient suffers from a marked degree of anorexia, and there is no reason why he should during this time, which means during the first two or three days, be forced to take any nourishment whatever.

As the period of calm sets in, and as the temperature begins to fall, appetite returns, and the patient may exhibit a great craving for food. In spite of this craving, all food should be withheld, except small quantities of milk and lime water, with perhaps a little chicken-tea. As defervescence becomes complete, the quantities may be increased, and as convalescence proceeds a semi-fluid diet may be cautiously begun. All solid food, however, should be rigidly withheld until it is quite apparent that convalescence is thoroughly established, since any indiscretion of diet during the period of defervescence and the early days of convalescence is frequently followed by a relapse. Relapses in yellow fever are extremely dangerous, and everything that lies in the physician's power should be done to prevent their occurrence.

If vomiting is troublesome during the period of calm and defervescence, no attempt should be made to give anything more than very small quantities of milk and lime water, and nutrition can be aided by the use of nutrient and saline enemata.

Epidemiology.—Yellow fever is endemic in certain regions, and, as far as its endemic habitat is concerned, it has a very restricted geographical distribution. The centre from which it spreads is the West Indies, and it extends north to Mexico and the southern States, west to Central America, and south to the coast of Brazil. Until quite recently the disease was always present in Havana, and in the large coast cities of Brazil it has been endemic since it was introduced into Bahia from New Orleans. In New

Orleans, Monte Video, and Buenos Ayres the disease must be said to be endemic, in so far as it arises in these cities without any known case being introduced from outside, but of late years its behaviour has been rather epidemic in these places, and several years may pass without the appearance of a case. It is, however, always present in some of the islands of the West Indies. Since the occupation of Cuba by the United States, yellow fever has practically disappeared from Havana, and since the administration by the United States of the region traversed by the Panama Canal a similar result has followed. The disease is undoubtedly endemic in certain parts of West Africa, but it is not known whether or not this region is its original home. Epidemics have occurred in various places as the result of infection carried from the West Indies or elsewhere, and such epidemics have been severe in Spain and Portugal. On one occasion the disease was carried from Spain to Italy. Although the epidemics in Spain and Portugal have sometimes reached large dimensions, the disease has never taken a permanent hold in any European country. Cases have been known to occur in certain seaport towns in England and France, but only in small groups, and as the result of known infection introduced by some ship on which the disease had broken out.

The climate which favours the occurrence of yellow fever is one where the temperature does not fall lower than about 70° F., and which is damp, and the disease tends, therefore, to spread in tropical and sub-tropical climates during the rainy season. An epidemic always ceases as freezing point is approached.

The disease is confined mainly to seacoast towns, and towns which are situated on the banks of rivers and in flat, swampy country. It does not as a rule travel far inland, and is uncommon at high altitudes. It has, however, broken out in towns like Sao Paulo in Brazil and Newcastle in Jamaica, where the elevation is somewhere about 2,500 ft., and it has also broken out in Cuzco in Peru, where the elevation is over 9,000 ft.

The disease is not rapidly spread in rural communities: it is essentially a disease of large towns.

At one time ships were very prone to be attacked in the West Indies and the low-lying insanitary districts in the neighbourhood of wharves and docks in towns like New Orleans.

It is a matter of common observation that if a patient is removed from an endemic area, and means are taken to isolate him properly, not only from his fellows but from mosquitoes, he will not spread the disease, and it is therefore quite safe to visit a yellow fever patient under these circumstances. The disease, however, can be acquired in places where it is endemic without coming into direct contact with any patient.

Prolonged residence in a place where yellow fever is common seems to bestow a certain amount of immunity on many people, even though they may never have had a definite attack of the disease. It is probable that such people become immunised by small and repeated doses of the virus without developing a true attack of yellow fever.

Method of Infection.—There is no doubt nowadays that yellow fever is due to the action of some parasitic germ which acts powerfully on the red blood corpuscles, and this germ is present in some form or another in the blood stream during the first three days of an attack of yellow fever. The germ is apparently so small as to be invisible through the microscope, and will pass through a Berkefeld laboratory filter and also through the Chamberland porcelain filter F., although it seems to be arrested by the Chamberland filter B. This is proved by the fact that inoculation with the blood of a patient suffering from yellow fever during the first three days of illness, whether the blood be fresh, defribinated or filtered through a Berkefeld filter or a Chamberland porcelain F., will produce yellow fever in a susceptible person. The disease is transmissible apparently only through the agency of a certain type of mosquito, namely, the Stegomyia fasciata, and then only after a certain time has elapsed after the infection of the mosquito by virulent blood. It seems that an incubation period in the mosquito of from twelve to fourteen days is necessary before the mosquito is capable of transmitting the disease to man. Endeavours to infect

susceptible human beings with mosquitoes from two to ten days after being fed have been hitherto unsuccessful. An infected mosquito has been known to communicate yellow fever at fifty-seven days after infection, and it seems likely that the infection becomes more virulent after a mosquito has been kept for a considerable time after infection, especially if it is kept at a temperature of about 27° or 28° C.

Marchoux and Simond have made a series of experiments of extreme interest which go to show that the virus in yellow fever can be transmitted by the infected parent to a new generation of insects. The eggs of a Stegomyia, aged twenty days, which had been fed on several yellow fever patients, were hatched, and after they reached maturity the new generation of mosquitoes were fed on glucose for a fortnight. One of these young Stegomyia was made to bite a susceptible person who had recently arrived in Brazil, and who was guarded against all possibility of otherwise acquiring the infection. No yellow fever followed. A week later that same person was bitten again by the same mosquito, with the result that he was seized with a typical, although mild, attack of yellow fever, with characteristic vomiting, pains, fever and icterus. After he recovered from this attack he was repeatedly bitten by infected mosquitoes, but remained quite immune. An interesting point which emerges from this experiment is that a mosquito which has just become infected cannot transmit the disease until it has been fed on blood.

Some observers have noticed another interesting point with regard to the Stegomyia fasciata; namely, that before the female Stegomyia can lay eggs she must first have a feed of blood, and the eggs are deposited about three days after she has so fed. Before the first egg-laying, the Stegomyia fasciata feeds both during the day and during the night, biting at any time. After the first egg-laying, however, she bites only at night. Therefore, a Stegomyia that bites during the day does not convey yellow fever, since she is too young, and any parasite she may harbour is not mature. Thus a yellow fever centre may be visited with impunity during the

day even though the person may be bitten by mosquitoes, but becomes dangerous at night, so that Europeans who live in the suburbs of certain towns in which yellow fever is endemic may go to business in the low-lying insanitary districts of the city and will not contract the disease unless they actually spend certain hours of the late evening or night in the infected areas.

The knowledge which observers in the United States Medical Service gained as to the methods of infection in yellow fever and the habits of the Stegomyia were applied in the most practical way, both in Cuba and in Panama, with the result that the incidence of the disease in these regions has been lessened almost beyond belief since their administration by the United States.

Period of Infectivity.—It seems probable that a patient suffering from yellow fever is not capable of infecting mosquitoes after the first three or four days of illness, and therefore after that period he ceases to be a danger to the community.

Death Rate.—The death rate of yellow fever is a very variable quantity. In places where the disease is endemic, or where it appears at frequent intervals in epidemic form, the majority of the adult population are comparatively insusceptible, as the disease appears for the most part among new-comers and in children. In children the manifestations of the disease are usually rather mild, and thus the mortality rate of yellow fever in such districts may be quite low. On an average, the death rate may be said to vary from 12 per cent. to 80 per cent., but may be even lower in districts where the disease is endemic, and where new-comers are few. In an epidemic which occurred in Rio de Janeiro in 1898, the death rate reached the extraordinary height of 94 per cent. A death rate of between 25 per cent. and 30 per cent. is quite usual among unacclimatised people. It is to be noted that epidemics of yellow fever in high latitudes where the disease has never become endemic, such as in Spain and other European countries, are usually attended by a high death rate, the mortality rising to something over 50 per cent.

The height of the fever in the acute period of the attack gives a good indication for prognosis. According to Sternberg, if the temperature does not rise over 103° F. the prognosis is good, whereas if the temperature is over 105° F. the prognosis is almost hopeless, and if the maximum temperature reaches between 104° and 105° F. the odds on recovery are about level. There is no doubt that insanitary living and dissipation make the chances of recovery from yellow fever much less favourable. Different epidemics in the same district may vary very much in severity, some showing a very low death rate, and others appearing to be very virulent.

Second Attacks and Relapses.—Second attacks of yellow fever are very rare. Relapses are extremely dangerous, and usually occur as the result of injudicious feeding or surface chill.

Prophylaxis.—The prevention of yellow fever depends largely on the destruction of the Stegomyia and on preventing mosquitoes from being infected by a patient.

A patient suffering from yellow fever should, if possible, be removed to hospital, and there placed in bed surrounded with mosquito netting, and the removal of the patient should be carried out as early as possible in the illness, seeing that it is during the first three or four days of the attack that he can readily infect the mosquito. Where it is impossible to remove him to hospital, his bed should be surrounded with mosquito netting, and the room should be fumigated thoroughly with pyrethrum. Pyrethrum stupefies the insects, which may be collected and destroyed while in a stupefied condition. When a patient has been removed to hospital the whole house and the houses adjoining should be subjected to a rigorous disinfection, and, seeing that it is of more importance to destroy insect life in these houses than to remove infection from clothing or the furniture of the room, the best method of disinfection is by sulphur dioxide. It is enough for thorough disinfection to burn sulphur in a room to the amount of a pound and a half per 1,000 cubic feet. Bedding and clothing soiled by the discharges of a yellow fever patient should be thoroughly disinfected, not so much from the point

of view that the discharges can themselves carry the disease to other people, but because clothing and bedding may contain infected mosquitoes.

Measures to be adopted against the Stegomyia are similar in every respect to those recommended to be taken in the case of malarious districts. The Stegomyia is a mosquito which tends to breed near dwelling houses, and it is of the utmost importance to see that all standing water in the neighbourhood of houses is removed. Pavements of court-yards must be repaired, so that water does not collect there and form more or less permanent puddles, while broken bottles, jars, empty cans and barrels are dangerous in so far as they collect water and form a good breeding place for the mosquito. Where the water supply is dependent upon cisterns and tanks these receptacles should be carefully covered with gauze. The district must be drained properly, irregularities in streets must be filled up, and pools of water which are impossible of drainage should, as recommended in the measures to be taken against malaria, be covered with a layer of petroleum.

Ships visiting infected ports should be anchored as far as possible from the shore and from infected vessels. As little communication with the shore as possible should be made, and no one should be permitted to leave the ship for shore after sundown. Should a case break out on board a vessel, he should be immediately taken on shore and isolated, the ship should be thoroughly disinfected, the holds being fumigated with sulphur before the removal of the hatches, and the whole vessel, indeed, carefully disinfected with sulphur dioxide. Water tanks must be protected with gauze as on shore. No one should be allowed to leave the ship after the occurrence of a case of yellow fever on board until some thirteen days have elapsed, and where it is all possible the vessel should be steered at once for cold latitudes, where the mosquito will not live.

While the disease is quite definitely propagated by the mosquito, and personal prophylaxis consists largely in avoiding infected areas after sundown, there is no doubt that overfatigue, undue exposure of sun, and dissipation all tend to

render a person more liable to infection, and people who have to live in the neighbourhood of infected areas should take the greatest possible care to avoid the sun in the middle of the day, and should live as far as possible quiet and regular lives and avoid alcohol.

Quinine and arsenic have been employed as prophylactic drugs at various times and in various places, but such medication seems to be of little use.

Chapter XXIV.

WHOOPING-COUGH.

Synonyms :—Pertussis; chincough.

French: Coqueluche.

German: Keuchhusten.

Definition.—An acute infectious disorder characterised by general catarrh of the air passages and repeated paroxysms of convulsive coughing with crowing inspiration, the paroxysms of coughing being frequently followed by vomiting.

Rash.—The disease is not accompanied by a specific rash.

Incubation Period.—The incubation period in whooping-cough is very variable, and on account of its insidious onset and the very slight catarrhal manifestations with which the attack usually commences, it is very difficult to be definite. It would seem likely, however, that the incubation stage may vary from a few days to a fortnight. In most cases its duration is probably between five and eight days.

Clinical Types.—The earliest indications of an attack of whooping-cough are those of a naso-pharyngeal catarrh. Occasionally sneezing and lachrymation are present, with much coryza, but as a rule a little running at the nose and a frequent short cough are the main symptoms which usher in the attack. In most cases there is a considerable amount of general malaise, and the patient is rather dull and listless, taking but little interest in his ordinary surroundings. The appetite is at first well maintained, but tends to fail as the attack develops. At first the cough, although frequent, is

not at all paroxysmal, and there is nothing to indicate that the child is suffering from anything more than an ordinary naso-pharyngeal catarrh. As the days go on, however, the cough increases greatly in severity, and tends to occur in paroxysms at more or less regular intervals. Laryngitis is sometimes noticed at this period of illness, but is not so common in whooping-cough as in measles. During the early stages of the attack the patient's sleep is usually broken and disturbed, and it is most commonly at night that the paroxysmal character of the cough first becomes apparent. As the cough begins to occur regularly in paroxysms a tendency to vomit after a paroxysm is very often noticed, especially if the paroxysm has been severe. The rapidity with which the paroxysmal character of the cough develops after the first onset of catarrhal symptoms varies enormously. In very severe cases the cough may be definitely paroxysmal, accompanied by a crowing inspiration and vomiting after a paroxysm, within three or four days of the first indication of illness, while in other less severe cases the paroxysmal nature of the cough may be little evident at first, and no whoop may appear for several weeks. As a rule, however, paroxysmal cough is well developed between a week and a fortnight after the onset of illness.

It is quite usual to have comparatively early in the catarrhal stage of the attack a little catarrh of the larger bronchi, so that auscultation reveals the presence of some coarse rhonchi all over the chest, and in some cases, usually of a severe type, a widespread catarrh affecting even the smaller bronchi may be present almost from the beginning. As a rule, however, the signs of bronchial catarrh are very slight as compared with the frequency, persistence, and violence of the cough, so that the fact of a child developing a paroxysmal cough with very few signs of bronchial catarrh should in itself make the physician suspicious of whooping-cough.

The amount of fever present in the pre-paroxysmal stage of whooping-cough is very variable. As a rule the elevation

of temperature is very slight, usually below 100° F., but in some cases the temperature may be raised to between 100° and 102° F.

It is in the paroxysmal stage that the cough assumes the characters which are typical of the disease. The cough occurs in definite paroxysms of varying duration and frequency, with periods of complete rest between. A typical paroxysm consists of a number of short explosive coughs following one another in very rapid succession, as Claude B. Ker suggests, like the explosions of a motor bicycle in starting. This series of rapid coughs usually lasts from about fifteen to thirty seconds, and is followed by a difficult inspiration made apparently through a greatly narrowed glottis, and this inspiration is accompanied by the crowing sound which forms the whoop so characteristic of the disease. In many cases the paroxysm is now ended, but in others, perhaps the greater number of cases, the process is repeated, so that the paroxysm may consist of many attacks of rapid explosive coughs lasting some fifteen to thirty seconds interrupted by a number of crowing inspirations or whoops. The paroxysm is not infrequently terminated by an attack of vomiting, and in those cases where vomiting does not occur a large amount of glairy mucus is expelled from the mouth at the end of a paroxysm. This expulsion of mucus occurs even in very young children, and the fact that a fit of coughing is followed by the expectoration of mucus in a child who is below the age at which expectoration is usually possible is of itself very suggestive of whooping-cough. While fifteen to thirty seconds is a common period for the rapid coughing to continue before an inspiration occurs, in very bad cases the rapid coughs may continue for forty-five seconds, or even rather more than a minute, before the patient is relieved by a successful inspiration, even of a crowing and unsatisfactory kind. It is true that during the occurrence of such an attack there may be momentary cessation of the coughing and an attempt to take breath, but the attempt may be more than once unsuccessful before the coughing is interrupted by a crowing inspiration.

The distress of the patient during such an attack is terrible. The face grows purple, the eyes are suffused and blood-shot, and the lips may be almost black; glairy mucus comes from the nostrils and the mouth, the tongue is protruded, swollen and very dark in colour, and bleeding may occur from the pressure of the *fraenum linguæ* on the teeth of the lower jaw. In rare cases syncope and death have occurred in such paroxysms, but as a rule just as the case appears to be *in extremis* a relaxation of the glottis occurs, and an inspiration relieves the condition.

The number of paroxysms which occur in twenty-four hours may be as high as twenty-four and as low as one, but ten or twelve paroxysms is a very usual number. It is curious to observe the extraordinary variation of attacks of whooping-cough both as regards frequency and duration of paroxysms in different individuals of the same family during the same epidemic. While one child may have during the day two or three paroxysms of short duration, followed by easy vomiting, and be otherwise in no way disturbed, another may be fretted both day and night by the occurrence of a paroxysm almost every hour, a paroxysm which may be composed of very many attacks of frequent coughing interrupted by crowing inspiration before it is terminated by vomiting or a spluttering expectoration of mucus.

As a rule, the child has a definite warning of the occurrence of a paroxysm, and becomes restless, seizes the side of his bed, clings to anyone within reach, and possibly cries. As a rule the crying is immediately followed by the occurrence of the paroxysm. The warning appears to be either a tickling sensation in the throat or behind the sternum or a sense of constriction in the chest; in some cases it appears to be a sensation of giddiness, accompanied by yawning, or it may be that the child is seized with an attack of sneezing. This warning occurs as a rule a few minutes before a paroxysm. The taking of food or drink will often precipitate a paroxysm, and this in severe cases is a great inconvenience, seeing that when a paroxysm occurs immediately after a meal

much of the food is likely to be vomited, and it is very difficult to maintain the nutrition of a patient under these conditions.

During the paroxysm the pulse rate is greatly accelerated, but unless the attack be very severe and the paroxysms frequent and prolonged the pulse rate drops to normal between the paroxysms, and the child is in other respects quite comfortable.

The paroxysmal stage of the disease lasts as a rule for about a month or six weeks, although in certain cases it may be shorter and in others much longer. It is usually at its worst during the second and third weeks, and thereafter the attack gradually passes off, the paroxysms becoming less frequent and less severe, until they disappear altogether.

The danger of an attack of whooping-cough depends largely upon the age and condition of the patient. An attack during the first three years of life is apt to be much more dangerous than one occurring in an older child. This, of course, depends to a great extent upon the fact that very young children are incapable of the serious and prolonged effort necessary to weather a severe and possibly complicated attack of whooping-cough, and also, as in all catarrhal illnesses in children, the mortality tends to be higher before the age at which nose-blowing and expectoration become easy than after it. Rickety children are badly handicapped from the start, both on account of the softness of their chest wall, and from the fact that they are curiously prone to bronchial catarrh and broncho-pneumonia.

Complications.—The most important complications which occur during the course of whooping-cough are those connected with the respiratory system. It is probably true that a *bronchial catarrh* is so common that it can scarcely be classed as a complication, but whereas it is usually slight and confined to the larger bronchi it is sometimes severe and of a capillary kind. The bronchial catarrh is dangerous in proportion to the extent of involvement of the small bronchi.

Broncho-pneumonia is a frequent and dangerous complication. In the course of a broncho-pneumonia the whoop is

usually suppressed, but sometimes a spasm of the glottis may occur which is a grave danger. *Laryngitis* may occur in whooping-cough as in measles, in connection with the broncho-pneumonia, but less commonly. *Collapse of the lung* occurs usually in association with broncho-pneumonia. If the collapse involves a large area, especially in infants, alarming symptoms may suddenly arise, and the child may fall back livid, with shallow and rapid respirations, cold and clammy skin. Sudden syncope and death may occur immediately, or a series of convulsions may result. In infants, broncho-pneumonia is nearly always fatal, particularly if there is any extensive collapse of the lung, and even in older children it is a complication of considerable gravity. Broncho-pneumonia usually attacks the lower part of the lungs, and in association with this condition a certain amount of *compensatory emphysema* is usual. In severe protracted cases the emphysema may be extensive and persistent through convalescence, and the patient may remain for life hampered with this condition from very early years. The temperature in whooping-cough after the first week is usually normal unless some pulmonary complication occurs, and any considerable rise in temperature should always suggest the occurrence of broncho-pneumonia.

Lobar pneumonia is a very rare complication, as is *pleurisy with effusion*, but both are occasionally met with. The usual time for pulmonary complications to occur is about the second or third week of the paroxysmal stage of the disease.

Convulsions are frequently met with as a complication of whooping-cough, sometimes alone but very frequently in association with a capillary bronchitis or a broncho-pneumonia. When they occur they should always excite alarm in the mind of the physican, since while they are sometimes infrequent and slight they are often severe, and even, especially when associated with a pulmonary complication, fatal. The convulsions are probably in most cases part of the general toxic condition of the patient, and in the majority of autopsies conducted on cases who have suffered

from convulsions in the course of whooping-cough no gross lesion of the brain is found. In a certain proportion of cases, however, the convulsions seem to be due to the rupture of cerebral arteries or thrombosis of veins and sinuses. They occur more frequently in rickety children and in children who are in the process of teething than in any other kind of case. In other words, they occur most readily in those patients who are most prone to suffer from the general nervous irritability so characteristic of whooping-cough. In some cases they indicate the onset of a pulmonary complication, taking the place as in other diseases of the rigor of adults. Convulsions usually occur in severe and complicated cases, but they do occur in cases otherwise very mild, and while in this latter class they are commonly slight and transient, they may sometimes be troublesome and even dangerous.

Various *hæmorrhages* due to the strain of coughing are often seen in whooping-cough. Bleeding from the nose is common, and a slight bleeding from the pharynx and bronchi is also fairly frequent. Sub-conjunctival hæmorrhages are common, and hæmorrhage into the eyelids, giving the appearance of an ordinary "black-eye," is sometimes met with. Blood coming from the nose is often swallowed, and may be vomited, or, passing downwards into the bowel, may produce melaena. Hæmorrhage from the ear either with or without rupture of the tympanum has occasionally been noted as a very rare complication of whooping-cough.

Disturbances of the digestive tract are also common. Vomiting, while usually the direct result of the paroxysms of coughing, may occur quite independently of these paroxysms, and the vomited material contains large quantities of thick ropy mucus. Digestion is difficult, and distention of the stomach is common. *Diarrhœa*, with thin, watery and sometimes mucous stools, is a very frequent complication of whooping-cough, and may be difficult to check. In a previously strong and healthy child digestive disturbances do not usually give cause for any anxiety, but in weakly children

they are dangerous in so far as they render difficult the adequate maintenance of nutrition. *Prolapse of the rectum* and *hernia* may occur, being due to the frequently repeated strain of coughing. Minute quantities of albumin and sugar are very frequently found in the urine, but true *nephritis* is a complication of great rarity. Acute *dilatation of the heart* with pulmonary œdema has occasionally been observed, but is very uncommon. When it does occur it is usually fatal.

Sequelæ.—The most important sequela of whooping-cough is tuberculosis in its various forms. It would seem that the child who has been weakened by whooping-cough falls a ready prey to infection by the tubercle bacillus, which has either been acquired after he begins to go about again, or has been dormant in his tissues before the development of whooping-cough. While pulmonary tuberculosis is the most common form which occurs in children who have had a prolonged broncho-pneumonia, tubercle of the lymphatic glands and even bone is also not uncommon. *Rickets* is frequently met with as a sequela of whooping-cough, and in cases where rickets has been present before the attack the deformity of the chest resulting from the strain of coughing may be very great. *Emphysema* with a tendency to bronchitis and asthma may persist through life as the result of an attack of whooping-cough in childhood.

Children remain irritable for long after the attack of whooping-cough has passed, and often suffer from unreasonable terrors, both during the day and at night. In many children any slight catarrh which occurs after an attack of whooping-cough may during the next six months or a year be accompanied by cough of a paroxysmal character and frequently a well developed whoop which may suggest a recrudescence of the disease.

A certain amount of *dilatation of the heart* may persist for a long time after the subsidence of a severe attack, and although as a rule this dilatation disappears completely in a reasonable time after convalescence is established, it would

seem that in some cases, at least, permanent damage to the heart may result. *Endocarditis* and *pericarditis* are practically never seen. *Chronic otitis media* is occasionally observed as a sequela, and is frequently associated with considerable enlargement of the cervical lymphatic glands.

Diagnosis.— The diagnosis of whooping-cough in the early catarrhal stage is extremely difficult, if not impossible. The cough at first is in no way typical, and although when an epidemic of whooping-cough is known to be in the neighbourhood any persistent catarrh with frequent cough should suggest the possibility of the attack being whooping-cough, it is not until the cough becomes less frequent and occurs in sudden attacks with intervals of rest between, although it may not be actually paroxysmal, that the case begins really to suggest the possibility of whooping-cough. Where whooping-cough is suspected the child should be observed carefully during the night, as it is almost always during the night that the true paroxysms begin to develop, and the first whoop occurs.

The examination of the blood may in many cases help one in diagnosis. It would appear that even comparatively early in the catarrhal stage a leukocytosis is very common, and as the cough approaches the paroxysmal type a relative increase in lymphocytes over polymorphs becomes apparent, sometimes in an extraordinary degree. But as the diagnosis of whooping-cough depends largely on busy practitioners it cannot be expected that they should employ this method of diagnosis, which is cumbersome and requires considerable technical skill.

In the paroxysmal stage when well developed the diagnosis is very easy. The sudden and explosive onset of the paroxysms and the occurrence of the whoop are absolutely diagnostic. Sometimes, however, the paroxysms are badly developed and no whoop occurs, and in such cases diagnosis even in the paroxysmal stage may be a matter of some difficulty. The spluttering occurring at the close of these ill-developed paroxysms is very suggestive, and the fact that at

their termination fairly copious expectoration of mucus occurs even in very young children, is often sufficient ground for a provisional diagnosis that may afterwards be verified by the development of a whoop. As mentioned earlier in the chapter, a persistent cough tending to be paroxysmal accompanied by the expectoration of mucus with practically no physical signs of bronchial catarrh in the chest should always make one suspect that the child is suffering from whooping-cough. The cough produced by enlarged tonsils and naso-pharyngeal catarrh is often very like whooping-cough, but the onset of the paroxysm is not so explosive, nor is the cough followed by the expectoration of mucus in very young children. The throat should always be examined to exclude the possibility of the cough being due to enlarged tonsils, and also because examination of the throat often excites a paroxysm which may render diagnosis certain. The discovery of a small ulcer on the *fraenum linguae* is strongly suggestive of whooping-cough, and puffiness of the eyelids and congestion of the eyes and face may also be taken as confirmatory evidence, but it is uncommon to have these conditions present in cases where the diagnosis is reasonably doubtful.

The catarrhal stage in whooping-cough associated with much coryza may suggest the onset of measles, but if no rash appears within a week and no Koplik's spots are evident, measles must be excluded. Foreign bodies in the larynx may produce paroxysms very like those of whooping-cough, and enlargement of the bronchial glands has been known to produce a cough which resembles very closely the whooping-cough paroxysm. In these conditions, however, the expectoration of mucus does not usually terminate the attack of cough.

Treatment.—In the treatment of whooping-cough the general care of the patient is of infinitely greater importance than any particular form of drug treatment. In treating a patient in a private house where there is sufficient accommodation for the proper management of the case, there is little doubt that the best and safest method of treatment is to confine the patient entirely to two rooms, one used during the

day, the other during the night, both kept at an even temperature, and ventilated properly without draught. Many people lay great stress upon the open-air treatment of whooping-cough, and it is possible that in cases who would otherwise be the inmates of crowded hospital wards, balcony and garden treatment is better than the alternative condition. It is, however, a dangerous doctrine to urge upon the general public, especially as at the present moment people are sufficiently heedless of the exposure to which they subject their children who suffer from whooping-cough in the early stages to need little encouragement in this direction. That the death-rate of whooping-cough is so high cannot be a matter of surprise when one sees the foolhardy way in which children who are evidently to the most superficial observer in the early stages of whooping-cough are permitted to go out and be taken out in the inclement east-windy weather of the English spring. It is surely unreasonable to expose a child to inclement weather and the risk of surface chill when the complaint from which he suffers is characterised largely by catarrhal symptoms, and the most fatal of whose complications are acute bronchitis and broncho-pneumonia. In whooping-cough as in every other disease the prevention of complications is of greater importance than their cure, and granted sufficient air for the child in well ventilated, evenly heated apartments, there should be, with proper recognition of early cases and reasonable care in the conduct of the case, a great reduction in the mortality of whooping-cough from these means alone.

The fact that whooping-cough is not notifiable is one of the great difficulties in its treatment. In the poorer classes of the community the gravity of infectious diseases is as a rule estimated only by the fact that the patients are either removable to hospital or are not, and measles and whooping-cough, whose death-rate is enormous as compared with the death-rate from scarlet fever, are looked upon by the poorer classes as trivial ailments unless a severe complication, such as broncho-pneumonia, should arise. It is to the careless handling of the case in its early stage that the enormous

death-rate in whooping-cough is largely due. Where possible, therefore, one cannot urge too strongly on any practitioner the importance of the early diagnosis of whooping-cough, and stringent treatment on suspicion. Hospital experience goes to show that in cases who are brought early to hospital during an epidemic of some size, the mortality rate is infinitely lower even in weakly and badly developed children than that in cases which have been allowed to drift into the second or third week of the paroxysmal stage before being sent to hospital. In private practice among patients of the better class this difference is even more extraordinary, and it is difficult to understand how after many years of experience certain practitioners persist in regarding whooping-cough in the early stage a trivial malady, and only institute careful treatment of the patient on the occurrence of bronchial catarrh or broncho-pneumonia. Since, however, the larger number of cases of whooping-cough which occur in this country appear in the homes of people who are unable perhaps to set apart even one room entirely for the treatment of the patient, one must devote some attention to the management of such cases in hospital. The open-air treatment, like the open-air treatment of phthisis, is in this country open to certain grievous inconveniences, and even dangers. One cannot believe that direct exposure to the bitter, inclement, and contaminated atmosphere of a city can be in any way beneficial to patients suffering from whooping-cough. It is better, therefore, in the management of such cases in hospital to treat them in large airy wards which are maintained at a regular temperature and well ventilated without draught, than to expose them on balconies or in the gardens of the hospital. If whooping-cough wards are allowed to be in any way over-crowded complications arise in a proportion of cases that is quite unjustifiable. If, however, the whooping-cough child is allotted an amount of space in the wards greater than that in any other infectious disease, save perhaps measles, and proper precautions are taken by the attendants to see that the mucus which is spluttered about at the end of a paroxysm is collected in a suitable spittoon, and the child's

mouth and face generally are carefully cleansed after each paroxysm, the chance of a ward becoming dangerously infected is enormously lessened. The spittoon should be placed within the easy reach of every child old enough or strong enough to use it, and the child must be trained to seize it at the commencement of every paroxysm, and spit into it at its close, while it ought to be the care of the nurse on duty in the ward to attend all weakly and very young children during a paroxysm, and encourage expectoration into the spittoon as the paroxysm terminates, cleaning the mouth and face after the mucus has ceased to be expectorated. Such precautions undoubtedly lessen the risk of grave complications arising in a whooping-cough ward, and in eight months out of our year, in any case, such measures are safer than any attempt at habitual open-air treatment.

If these remarks are true with regard to ordinary cases of whooping-cough without complications, they are doubly true of cases which are complicated by broncho-pneumonia during, at any rate, the acute stage. If, however, the broncho-pneumonia tends to be chronic and hang long in the wind during convalescence, it is certainly an excellent plan to have the child's bed taken into the open-air for the greater part of the day, when such weather as we can boast of permits. Damp, raw weather and the dry, cold east wind which stirs up the dust so easily are never conditions of climate to which one would wish even a chronic broncho-pneumonia exposed.

With regard to drug treatment it is impossible to devote space to discussion of all the medicaments which have been recommended. The medication of the atmosphere of the sick room by the volatilisation of creosote or eucalyptus has many advocates, and it is possible that the vapour of creosote may in some cases lessen the severity of the spasm. On the other hand, the medication of an atmosphere involves, to make it of any avail, a certain amount of deficiency in ordinary ventilation, and it would seem unlikely that the exclusion of pure

air would be in any way compensated for by the continuous inhalation of a drug.

Butyl-choral-hydrate, belladonna, the bromides, paregoric and other forms of opium, and many other drugs have been so strongly advocated that it would be almost heresy to say that in most cases they could all be dispensed with. Yet it is perfectly true. The average uncomplicated case of whooping-cough requires no drug treatment whatever, except when the paroxysms are very frequent and very severe. Of all the anti-spasmodics the tincture of belladonna and alcohol, preferably in the form of whisky, will probably be found to be of the greatest service in the treatment of such cases. It is necessary to push belladonna until its effects are very noticeable, until, indeed, the pupils are definitely dilated. It may be given even to young children in doses of from two or three minims every four hours, and this dose may be quietly increased every day by the addition of a minim to each dose until as large a dose as ten to fifteen minims thrice daily may be given. The condition of the pupil or the occurrence of a rash and signs of belladonna excitement show one that the limits of toleration have been reached. In very susceptible persons it may be found that a dose of even two or three minims of the tincture every four hours may be too much for their powers of toleration, in which case belladonna must be looked upon as a drug unsuited for their condition. Belladonna combined with small doses of sodium bromide, 2 or 3 grs. every three or four hours, will often be of service in diminishing the severity of the paroxysms, although it is very doubtful as to whether any drug treatment will reduce their frequency.

It is of the greatest importance that children who suffer from whooping-cough should have as much sleep as possible, at least during the night, that the intervals between their paroxysms should be as quiet and free from nervous excitement as possible. For this purpose the habit of giving 30 minims or a drachm of whisky with a little hot water and sugar towards the evening and continued, at least through the early part of the night, at intervals of two or three hours

is justified by experience, and where hypnotics are in any way necessary there is none so safe as whisky. Paregoric and Dover's powder are frequently of great service if used in a similar way, that is to say, in small doses and towards the end of the day, but many will agree that, where the danger of acute bronchitis and broncho-pneumonia is so great, the less opium that is used the better, especially in the case of very young children.

Where convulsions occur, the best drug to use is chloral hydrate, which should be given in an aqueous solution per rectum, either during or just after the occurrence of the first convulsion. It may be repeated twice daily as a preventive after the passing of the first convulsion, or given during or just at the end of each subsequent convulsion. If the convulsions are so severe as to be themselves dangerous, the inhalation of small quantities of chloroform is sometimes of great service.

If there is much diarrhœa small daily doses of grey powder at night combined with the washing out of the colon with a long soft tube is excellent practice.

The treatment of broncho-pneumonia and acute bronchitis must proceed along ordinary general lines.

To sum up, the most important part of the treatment of whooping-cough is the scrupulous care of the patient for some six weeks, the care to be as scrupulous in the early stages as in the acute, and also as scrupulous during the stage of decrudescence as in the acute. Fatal complications may arise as the result of carelessness towards the end of an attack, just as they do occur as the result of carelessness at the beginning of an attack.

Diet.—The diet in whooping-cough depends entirely on the severity of the case. In a mild uncomplicated case with no fever, where the paroxysms are few, no alteration in diet is necessary. If part of a meal is vomited the child is usually ready as soon as the paroxysm is over to eat again, and he should always be allowed to do so. Where the paroxysms are severe, and especially if there be some pulmonary complication, it is better to feed the patient frequently, if possible

always after a paroxysm, with small quantities of fluid or semi-fluid food. Milk, whey, a little clear soup, and light, easily digested milk foods will be found to be best in such cases. If there is evidence of much gastro-intestinal irritation it is well to feed the patient entirely on peptonised milk and barley water until the gastro-intestinal symptoms have passed. The addition of lime water to the milk often serves to lessen the tendency to acidity in the stomach. In some cases it will be found that a fluid diet tends to produce flatulence and gastric distension. In these cases it is best to allow the patient some soft solids, such as porridge, gruel, bread and milk, or rusks soaked in milk. Any solid food which has irritating crumbs will naturally be bad for the patient and encourage a paroxysm. As convalescence approaches and the paroxysms become less frequent a gradual resumption of the diet normal to the age of the child should be encouraged.

It is occasionally necessary to employ rectal feeding in cases who refuse food or whose digestive condition is such as to make it necessary to give the stomach a rest for a short time.

Epidemiology.—Whooping-cough is practically endemic in all our larger cities. It is more common and more severe in the so-called temperate climates than in warmer countries, but it has been carried practically all over the world. It tends to occur from time to time in widespread epidemic form, and has a seasonal prevalence during the spring months, which vary from February, March, and April in the south of England to April, May, and June in Scotland.

While whooping-cough is undoubtedly a specific disease, its bacteriology remains in doubt. Various organisms have been described as the causative agent. Afanassieff claimed to produce symptoms exactly resembling whooping-cough by the injection into the windpipe of dogs and rabbits of cultures of an elongated bacillus isolated from the bronchial mucus of patients suffering from whooping-cough. Similarly, Ritter cultivated a small diplococcus which occurred largely in chains, and claimed to be able to produce whooping-cough in the dog by injection of these cultures into the trachea. The

dog, however, is a bad subject for experiment in this disease, as it is evident that the injection of many organisms into the dog's trachea will produce paroxysmal cough. Bordet and Gengou claim also to have produced whooping-cough in young animals by inoculation with a short bacillus which they isolated from the bronchial secretion of persons suffering from whooping-cough. This organism, they state, is most likely to be found in the early stages of the disease. At the present moment, however, complete confirmation of the discovery of the specific virus of whooping-cough is needed.

There is no doubt that the infection of whooping-cough is spread by the nasal, pharyngeal and tracheal or bronchial secretion of the patient. Discharges from the nose and the sputum are undoubtedly infectious. It is said by some that whooping-cough is infectious only in the catarrhal stage, but it would seem more likely that the patient is infectious until defervescence of the attack is well advanced.

Whooping-cough attacks for the most part very young children. The vast majority of patients attacked are under four years of age, and it is quite common to find infants of six months to a year subjects of the disease. When it attacks adults it is seldom a dangerous, though always a troublesome disorder, although when, as sometimes happen, it attacks a person who is elderly, it may be dangerous on account of the strain thrown upon a heart and arteries which have already shown signs of degeneration.

Death Rate.—The hospital death-rate in whooping-cough is always very high, since whooping-cough is not a notifiable disease, and only children of the poorest classes are as a rule sent to hospital, and often not until they have developed such complications as make them dangerously ill. Johnston has given the mortality rate in Glasgow as 35 per cent. up till two years of age, 22 per cent. between two and three, 12 per cent. between three and four, 8 per cent. between four and five, and 6 per cent. between five and ten years. Taken over all, the hospital death-rate varies as a rule somewhere between 11 and 18 per cent. While this death-rate is large, it must be remembered that it applies only to the slum inhabitants

of most of our cities; it is not very common for children of the better classes to die of the disease. The high death-rate in our towns depends upon the miserable and ill nourished condition of the children attacked, and the lack of care which they receive both from their parents and the community in the early stages of the illness.

Home Prophylaxis.—All patients suffering from whooping-cough should be isolated, and in time of epidemic all children who suffer from a febrile catarrh should be isolated on suspicion. Patients should be kept isolated for six weeks after the paroxysmal stage has become definite, or until the whoop has disappeared. If the child has suffered from broncho-pneumonia it may be better to isolate him until the whoop has disappeared, even if the period should exceed that of six weeks. The attendant in the sick-room should always wear an overall, which should be left in the room when she leaves it. The discharges of the patient should be disinfected, spittoons should be used to receive the expectorated mucus, and this mucus must be disinfected before being thrown out. All handkerchiefs and clothing in contact with the patient should be soaked in suitable disinfectant fluid and boiled before being sent to the wash. The sick-room should be fumigated with sulphur or sprayed with formalin, and thoroughly aired and washed down at the conclusion of the case. It is not necessary to re-paint or re-paper a room after the occurrence of whooping-cough.

Public Health Administration.—It is difficult to lay down any rules with regard to the public health administration of whooping-cough, seeing that the disease is not notifiable. On the occurrence of an epidemic, however, it is wise to send as many patients to hospital as possible, especially from the poorer and more crowded districts of the city, and it would seem reasonable to suggest that during an epidemic of any size the visiting of the areas which are most crowded and in which most cases are arising should be undertaken at least in some measure by some of the health office staff. In this way it would be possible to lessen the mortality rate by supervision and advice while the disease is acute, and by the

encouragement of parents to take great care of the children who are in an early stage of the disease. Schools in the district should be examined daily, and any child suffering from catarrh should be sent home and not allowed to attend school until such time as is evident that he is not the subject of whooping-cough. It is doubtless impossible at the present moment to attempt anything like the notification of whooping-cough, as the proper accommodation for this disease and for measles would tax the already over-burdened ratepayer to a degree impossible of toleration. But the removal of as many cases as possible to hospital during an epidemic should be seriously encouraged.

ACUTE DISEASES FREQUENTLY ATTRIBUTED TO A DIET CONSISTING LARGELY OF CERTAIN CEREALS.

Chapter XXV.

BERIBERI.

Synonym: Kakke.

Definition.—A disease which occurs endemically and epidemically in tropical and sub-tropical climates, characterised by a specific multiple neuritis, and a notable tendency to cardiac failure; sometimes associated with œdema.

Incubation Period.—The incubation period of beriberi has not yet been definitely established, and, according to different observers, is variously stated to be somewhere between a few weeks and several months.

Rash.—No rash has been noted as typical of the disease.

Clinical Types.—Speaking roughly, there are two distinct types of beriberi; one which is characterised by extreme wasting of muscles and notable loss of fat, so that the patients appear extremely shrivelled and emaciated, and the other in which there is also weakness of muscles, but in which, at the outset at any rate, the patient is the subject of very marked œdema of the limbs, and perhaps of the whole body. The first class has been called "dry beriberi," the second "wet beriberi."

The *onset of the disease* is as a rule gradual, but in some cases the condition develops with great rapidity. The patient first of all complains of weakness, aching in the legs, palpitation and breathlessness. In some cases the legs or face become gradually œdematous in addition to these symptoms.

Dry beriberi: In this form of the disease, when the patient becomes ill enough to seek advice, there is marked wasting of the muscles of the legs, and, although to perhaps

a lesser extent, of the arms. The calves are shrunken and flabby, the muscles of the thigh are soft and wasted, the thenar and hypothenar eminences also show atrophy, and the muscles of the arm generally are weak, flabby, and shrunken. Deep pressure over the affected muscles elicits a considerable degree of tenderness. The deep reflexes are diminished or absent; the muscles quite early in the disease tend to exhibit the reaction of degeneration on being tested electrically; the superficial reflexes are present, and are sometimes very active. There is as a rule no interference with the function of the sphincters. The hands and limbs are ataxic, so that when the patient tries to walk his gait exhibits a great deal of muscular inco-ordination, and similarly any finer movements of the hands and fingers are performed with great difficulty and fumbling. The movements of the hands and limbs are difficult, not only on account of the ataxia, but on account of the great degree of muscular weakness which is present. The patient may be quite unable to raise the limbs in bed, and the fumbling and difficulty in connection with the finer movements of the hands is as much due to loss of muscular power as to real ataxia. There is no tremor of the hands. Ankle drop is common. It is not usual to find atrophy of the muscles of the face, the ocular muscles, the muscles of mastication, or the muscles of the tongue or pharynx. Besides the loss of power and wasting in the muscles a certain amount of anæsthesia of the skin is very common, particularly over the front of the shins, the thighs, the dorsum of the foot, and the finger tips. This anæsthesia also contributes to the general inco-ordination of the patient's movements. The condition is thus evidently due to a multiple neuritis.

The tongue is as a rule clean, the urine presents no abnormality, and the bowels are fairly active. There is frequently, however, some feeling of distention and oppression in the epigastric region after a meal.

In some cases no other symptoms than those mentioned present themselves, but in the majority of patients who are affected with beriberi, even of the dry type, there is greater or lesser cardiac distress. The patient suffers from breathlessness

on exertion, and also from palpitation. The pulse tends to be soft and rapid, and the carotids throb violently. On examination of the chest the apex impulse is found to be diffuse, and epigastric pulsation is very common. On percussion, the area of præcordial dullness is usually enlarged, especially to the right, and this enlargement may be very considerable. On auscultation, systolic murmurs may be audible, either at the apex, in the tricuspid area, or at the base of the heart, sometimes in all three situations. Reduplication of the first sound at the apex and of the second sound at the base is very common, and the ventricular sounds are sharp and slapping, while the long pause is noticeably shortened, so that the heart's sounds are equally distant from each other, and resemble the ticking of a clock. The degree of cardiac distress varies very much in different cases, and may vary considerably from day to day in the same case. The murmurs are not always audible, but may be present one day and absent the next. The degree of cardiac dilatation is also inconstant, and daily observations will show considerable variation in the extension of the præcordial area of dullness to right or left.

The disease may clear up within a few days of its appearance, and leave the patient perfectly well, or it may run a protracted course, lasting for months. Throughout the attack acute cardiac failure is liable to occur, so that the patient may die suddenly of syncope, or may be seized by urgent dyspnœa and become cyanosed, suffering from cardiac distress and præcordial and epigastric pain. The pulse is rapid, feeble and irregular, the extremities are cold, and death may occur after a few hours of suffering and struggling. Œdema of the lungs is common in such cases, and effusion into the pleura or pericardium may also occur. In certain cases death may ensue as the result of a paralysis of the diaphragm and intercostal muscles, but in most instances death is due to cardiac failure, more or less rapid.

When recovery takes place it is usually slow. The wasting of the muscles is arrested, hyperalgesia disappears, the limbs become fuller, muscular power gradually returns,

and the deep reflexes reappear. Recovery is in most instances complete, although in some cases there may be a permanent atrophy of certain groups of muscles in the arm or leg, with resulting deformity, or the patient may suffer from a permanently weakened and dilated heart.

While the onset of the disease is usually gradual it sometimes happens that a patient who has gone to bed quite well may waken up in the morning with marked paresis of his limbs, and thereafter the disease may progress with great rapidity.

Wet beriberi: In this type of the disease the striking feature is a marked œdema of the face, hands and feet. The patient is usually very short of breath, and the lips and face may be slightly cyanosed. He bears a superficial resemblance to an ordinary case of acute nephritis, but, although the urine is usually dark, scanty, and of high specific gravity, it contains no blood, and albumin is usually absent, or if present, it appears as a mere trace. The œdema, too, is distinctly firmer than that which is met with in nephritis, and in many cases does not involve the scrotum.

Examination of the heart reveals signs of dilatation and weakness; slight effusion into the pleura is quite common, and a certain amount of œdema of the lungs is not infrequent.

The deep reflexes are diminished or absent; "dropped ankle" is common, and on firm pressure over the calf muscles it will be found, in most cases, that they are hyperalgesic. A certain amount of anæsthesia of the skin over the shins and finger tips is usually present. The patient commonly complains of a feeling of distress referred to the præcordial region and epigastrium, and this distress is usually aggravated by the taking of food. The urine, as has been indicated, is dark coloured and very scanty; indeed, in many cases only a few ounces are passed in the twenty-four hours. It will be seen that in cases of this kind the patient suffers from a peripheral neuritis, with, in addition, an œdema which is

firmer than that which is usually met with in acute nephritis, and which is probably not entirely cardiac in origin. The amount of œdema present may be much less than has been described above, and may be limited to the front of the legs, ankles and feet, with perhaps a little in the flanks and sacral region. Where the œdema is limited, the typical atrophy of muscles is, of course, more apparent. Sometimes the œdema is very limited and transient, so that it is not apparent except on careful examination.

Patients suffering from "wet" beriberi are more liable to sudden and severe attacks of cardiac failure than those who suffer from the "dry" type of the disease. In most cases which recover the œdema disappears, leaving the patient wasted and shrunken, as has been described in cases of "dry" beriberi, and convalescence progresses in a similar way.

The *temperature* is not elevated at any stage of the disease, either in the "wet" or the "dry" type.

Sequelæ.—The most important sequelæ of beriberi are, as has been mentioned before, *permanent weakness of the cardiac muscle* and *permanent atrophy of one or more groups of muscles*. Fortunately, such sequelæ are not very common; recovery is usually complete, although convalescence is often very protracted.

Diagnosis.—As a rule, the diagnosis of beriberi is not a difficult matter. Epidemics of multiple peripheral neuritis occurring in a place or ship in which similar epidemics have arisen before are, in the absence of any definite evidence of wholesale arsenical poisoning, almost certainly due to beriberi. If, in addition to the ordinary signs of peripheral neuritis, there is a tendency for œdema and cardiac disturbance to appear in a certain proportion of the cases, the diagnosis of beriberi is the more certain. Where the attack of beriberi is mild it is frequently diagnosed, by those who have not had much experience of the disease, as a "rheumatic" or "malarial" affection, more particularly as in mild attacks the patient complains merely of a little weakness and pain in the legs, and any œdema that is present is so slight as not to be apparent except on very careful examination. In the tropics any person who complains of pain in the legs and

shows a little anæsthesia and œdema over the front of the shins should be carefully examined, and if hyperalgesia of the muscles of the calf is discovered and the knee reflexes are found to be diminished or absent, the case should be looked upon as beriberi, and dealt with accordingly.

It is to be remembered that even in cases of beriberi which are very slight as regards paresis and œdema, sudden cardiac failure may occur, and it is important to recognise the disease even when its manifestations are apparently very mild, on account of the possibility of a fatal termination to a case whose symptoms, other than cardiac disturbance, may be so slight as easily to escape notice.

Sporadic cases are apt to be attributed to alcoholism, malaria or poisoning by arsenic, on account of the history of the patient, and such sporadic cases are doubtless frequently missed.

During an epidemic, too, it is sometimes difficult to separate cases of beriberi from cases of peripheral neuritis which occur from quite other causes.

Treatment.—A patient suffering from beriberi should be removed at once from the house or ship in which he probably contracted the disease, and should be put to bed and kept there strictly until convalescence is so far established as to make the occurrence of cardiac failure at least improbable. It is important that, although the patient is in bed, he should have abundance of fresh air, and, if possible, sun-light, so that the verandah of the hospital is a suitable place for him to spend at least the day-time.

Cardiac failure must be dealt with in the usual way, and strychnine has been recommended, combined with small doses of digitalis or strophanthus. Where acute cardiac distress appears with much cyanosis, nitro-glycerine and nitrite of amyl should be given, and bleeding has frequently served to relieve a greatly embarrassed right heart. The bleeding should be just sufficient to relieve temporary distress, and may be repeated should the attacks recur, as they most usually do. The inhalation of oxygen is also recommended in such cases. In any case where there is much cardiac distress the possibility of its being due to a pleural effusion

should be remembered, and any fluid present in the pleura should be drawn off.

Where there is much wasting of the muscles it is necessary to be very careful to avoid the possibility of permanent deformity. This is particularly necessary where the foot is "dropped," and in such cases it is well, as in infantile palsy, to correct the deformity by means of a splint. The wasted muscles should be treated by massage and mild faradism as soon as the hyperalgesia of the muscles has subsided, and repeated small doses of strychnine given hypodermically are also recommended at this stage of the disease.

As convalescence is established a complete change of scene is useful, and where at all possible, the patient ought not to return, for some time at least, to a region where beriberi is prevalent, since the return to such a district too early often induces a relapse.

Diet.—In beriberi the diet should be fairly generous, but great care must be taken not to overload the stomach at any meal. It is important that the patient should have a good proportion of nitrogenous food and fat in his dietary. Milk and eggs and a certain amount of meat ought to be given. Rice, on account of its bulk, is not a very suitable article of diet for those suffering from beriberi, and should be replaced as far as possible by bread and oatmeal. In severe cases with a tendency to cardiac disturbance it may be necessary to limit the diet, at any rate during the period of distress, to milk and beaten-up eggs.

Epidemiology.—Beriberi is endemic in certain tropical and sub-tropical districts, particularly in the Malay Peninsula, China, Japan, and certain districts in India and Africa. It has been seen among the natives in Western Australia, and it exists in Brazil, in which country an extensive epidemic prevailed between 1860 and 1865. Cases have been reported from Lake Nyassa, from the Congo, Uganda, the West Indian Islands and the Sandwich Islands. An epidemic indistinguishable from beriberi broke out within late years in the Richmond Asylum, Dublin, and a similar disease has been seen in lunatic asylums in the United States of America and in France.

The disease prevails in districts which are damp and hot. In those regions which have no cold season the epidemic prevalence of beriberi is greater about the time of the rains. In countries where there is a hot and a cold season the epidemic prevalence is greater in the hot season, while during the cold season new cases do not appear and old cases tend to recover. The disease seems most readily to attack those who sleep near the ground. It is common alike in large cities and among the rural population. It has no apparent connection with standing water, swamps, or running water, so that it is unlikely that it is associated with the presence of mosquitoes or other biting flies. Overcrowding and lack of cleanliness seem to encourage the spread of beriberi, and it is particularly common in the East in gaols, schools, coolie camps and armies. It is also frequently met with in the overcrowded and unclean forecastles of eastern-going ships.

The disease attacks both children and adults, and both sexes are affected.

Like malaria, the disease may remain latent in the person attacked for a long time, and it is quite common to find Lascars and other members of ships' crews developing beriberi months after they have left regions in which it was possible for them to contract the disease.

Method of Infection.—No micro-organism has been discovered which can be said to be the cause of beriberi. Various bacteria have been described as having been found in cases suffering from this disease, but they have afterwards proved to be organisms of a non-pathogenic character.

Various theories have been propounded regarding the cause of beriberi, and the theory which has persisted most firmly up to the present time is that it is in some way due to feeding on certain kinds of rice. It has been supposed by some that the disease arises as the result of eating rice which is mouldy or otherwise deteriorated, and it has also been suggested that it is caused by a diet which consists almost exclusively of polished rice, that is to say, rice which has been deprived of the brown nitrogen-containing layer which exists between the white central portion of the grain, which

we in this country eat as rice, and the enveloping husk. Experiments have been made in certain places with the object of showing that natives who feed entirely on brown rice, that is to say, rice which has not been deprived of the nitrogenous layer, do not contract beriberi, while those who feed on polished rice are frequently attacked by the disease. In certain coolie camps it is maintained that the admixture of a certain proportion of brown rice with the polished rice which the coolies prefer, is sufficient to prevent the occurrence of beriberi in anything like serious epidemics. Some observers have stated that Eastern people, who, while at home, eat brown rice, are in the habit of taking polished rice with them for food when they go on a journey, and that during the time that their diet consists of polished rice they are liable to be attacked by beriberi. Those who have made these statements believe that the disease is the result of nitrogen starvation, due to the removal of the brown layer of the rice which is of high nitrogen value.

It is difficult to say how this theory can hold good, seeing that the disease attacks rich and poor in the East, that is to say, it attacks those who live almost entirely on rice, and those whose dietary, in respect of nitrogen, is at least as rich as that of a poor European.

Experiments have been made on the feeding of rats on polished rice, and some observers have noted that among rats fed in this way a disease similar to beriberi has appeared. In 1909 I carried out some feeding experiments in the University of Glasgow, during the course of which I fed a number of rats on a diet which consisted entirely of boiled rice. The result of the experiments was roughly as follows:— The rats, who ate large quantities of rice, maintained their weight, and even increased it, and all the time of the experiment stored nitrogen to a certain extent. Their general condition, however, deteriorated considerably. The females died in child-birth or shortly before full term, while the males, after a period of apparent health which lasted for many weeks, became infected with ordinary pyogenic organisms, and died of abscesses in the subcutaneous cellular tissue, the

liver, or the lungs. The rats were kept singly in metabolic cages, and their cleanliness was scrupulously attended to. In none of the rats was there any hint of paresis of legs or any sign of nerve degeneration.

The features common to the surroundings of all those who suffer from beriberi are overcrowding, heat, damp and lack of cleanliness. On ship-board beriberi is not invariably confined to the rice-fed crews of Eastern extraction, whether Mongolian or Lascar in type, but is also met with among European sailors, and even among the ship's officers, who are not in the habit of confining themselves to a dietary of rice. I recollect three cases of beriberi which were brought to hospital in Glasgow. The patients were all Frenchmen, and were sailors on board a small cargo steamer which had just returned from South America. On inquiring into the history of the ship it was found that on her previous voyage she had been East, and on the voyage home beriberi had broken out in the forecastle. She discharged her cargo in France, shipped a new crew, and went out to South America. On the return voyage to Glasgow beriberi again broke out, and the three cases were sent to hospital. In this group of cases there could be no suggestion that the disease was produced by the eating of rice, infected or uninfected, but on examination of the ship the forecastle was found to be unusually dirty and stuffy. Before the ship was permitted to leave port the forecastle was cleaned by the sanitary authorities in a way in which, from all appearances, it had never been cleaned before. With regard to these three cases it will be seen that the voyage from which they were returning did not include a visit to places where beriberi was at all prevalent, and the occurrence of the disease on two consecutive voyages in the same ship with a dirty forecastle suggests at once the probability that the disease was acquired in the forecastle, and not through any errors in diet.

A diet which consists largely or entirely of polished rice is of low nutritional value, and it may be that people who confine themselves to such a diet are unusually liable to infection by any organism, and, living as they do in districts in which beriberi is prevalent, they fall victims to the disease

more easily than those whose dietary is more varied and ample.

At present new evidence all goes to show that the disease is the result of infection by a specific germ which is conveyed to man by some intermediary, of the nature of the louse or bug. A more careful and detailed study of the endemic habitat of beriberi is necessary before one can be absolutely definite as to the means whereby infection is conveyed to man, but the study of outbreaks in gaols in the East goes to show that the disease will persist in certain gaols despite all change of diet, while other gaols remain free from the disease, despite the food which the prisoners eat. Patients taken from a healthy to an unhealthy gaol will develop the disease, and prisoners suffering from beriberi, if taken from an unhealthy to a healthy gaol, tend to recover after their transfer. Evidence like this is weighty, and is absolutely against the rice origin of beriberi; and further, reasoning on *a priori* grounds, it would seem to be a very curious thing if beriberi were to be left as the only specific disease in our nosology due to a dietetic fault and not to the introduction of some organic virus into the system, whether directly or through the mediation of some insect or parasitic vermin.

Death Rate. —The mortality rate of beriberi is a variable quantity, and it varies according to the type of the epidemic and the place in which the outbreak occurs. Speaking broadly, the death rate is higher in low-lying than in high districts, in acute than in chronic cases, and in those cases which are dropsical than in the dry or atrophic type of the disease. Manson gives the death-rate as varying in different places and in different epidemics from 5 to 30 per cent.

Prophylaxis. —As beriberi is not directly contagious, strict isolation of a patient is not absolutely necessary for the benefit of the community, but for his own sake he should be removed as speedily as possible from any district where the disease is known to be prevalent. Especially should he be removed from low-lying, overcrowded districts, and housed in a clean, airy building, well ventilated and situated on some elevation.

Looking upon the disease as due to some organic virus, possibly of a protozoal kind, and as probably carried by parasitic vermin, it stands to reason that in districts where beriberi is prevalent sanitary measures with regard to the encouragement of cleanliness and the prevention of overcrowding should be enforced as rigorously as the prevailing customs of the country permit. The forecastles of eastern-going ships should be repeatedly cleaned, not superficially but very thoroughly, woodwork should be kept in strict order, so that lice and other vermin may have little harbourage, and suitable disinfectants should be freely used. When the disease breaks out on board ship it is well to take the patient from the forecastle and keep him on deck, while such measures of disinfection of the forecastle as are possible at the time ought to be undertaken immediately.

Where it is possible, for example in coolie camps, the diet of the community in which the disease has broken out should be increased, if even by the addition of brown to white rice, and also by the introduction of fish and milk where this is at all feasible. As, however, the disease is endemic in cities and in countries which are notably averse to cleanliness and where the people are too poor to afford a very liberal or varied dietary, it is a matter of great difficulty in such districts to enforce any measures which may be effective in lessening the incidence of the disease.

Chapter XXVI.

PELLAGRA.

Synonyms.—The Rose; Alpine scurvy; Asturian leprosy; Italian scurvy.

French: Maladie des Saints Mains; Galle de St. Ignace.

German: Der Lombardische Aussatz.

Italian: Pellagra; mal del padrone; mal della spienza; scottatura di sole; mal salso, etc.

Spanish: Mal de la rosa; mal del monte; Flema salada.

Definition.—An endemic disease characterised by a group of symptoms involving the skin, the gastro-intestinal tract and the nervous system. The disease is characterised by periodic exacerbations and remissions.

Incubation Period.—The incubation period of pellagra is, as far as adults are concerned, very difficult to fix, and it is probable that the ordinary period of incubation described is rather long. During the time that the idea held more or less generally that the disease was due in some way to the eating of maize the incubation period was put down as something approaching several months in duration. Recent investigation has, however, shown that the incubation period may be very much shorter. Sambon has seen cases in infants as young as three months old, and quotes an interesting case of a child born in a gaol in Italy of a non-pellagrous mother and in a non-pellagrous district. This child was taken from the mother when it was five months old, and boarded out with strangers, who happened to live in a notably pellagrous district. The child developed pellagra in something like a fortnight, so that in this case the incubation period

cannot have been longer than a fortnight. It is quite probable that in some instances it may be less than a week.

Clinical Types.—The onset of pellagra is indicated by a feeling of general malaise, some gastro-intestinal disturbance, vertigo and the appearance of the characteristic rash. This rash appears on the face and the neck above the collar, and on the backs of the hands; in other words, on those parts of the body which are directly exposed to light and air. The rash as it appears at first resembles frequently an ordinary sunburn; the skin is reddened and slightly thickened and inflamed. In some instances the redness and inflammation are associated with the formation of a bullous eruption. As the disease usually makes its appearance for the first time in spring or early summer, the rash is very frequently mistaken for ordinary sunburn, and in those cases where the other symptoms are slight and obscure the mistake is natural enough. The severity of the rash varies very much in different cases. On its first appearance it may be very slight, resembling closely a mild degree of solar erythema, although it has a slightly different distribution. The backs of the hands are usually most involved, and when the face is implicated the forehead and cheeks are most definitely attacked. The eruption on the ears is not so marked. The appearance of the rash on the neck is very variable; in a great many cases the neck is not attacked at all, but when the rash does appear in this region it has a collar-like distribution which is very characteristic. A solar erythema is not so selective; the neck and the ears are affected equally with the face and hands. The eruption of pellagra may also affect the forearms, the legs and the upper part of the chest, if these regions have been exposed freely to light. The parts affected by the rash are irritable and burning. Sometimes petechiæ are present, although the eruption is usually of a frankly erythematous kind.

The degree of implication of the gastro-intestinal tract is also very variable. Some cases, indeed, may present no symptoms referable to the digestive tract; in others there may be only a slight furring of the tongue and a slight feeling of oppression in the epigastrium, associated with eructations

of gas, while in many cases there is quite marked distention of the epigastrium and lower part of the abdomen, and the patient suffers considerable pain in these regions, especially after food. The appetite is usually rather capricious. Sometimes the tongue is very thickly coated at the onset of the attack, but as the attack proceeds it loses its epithelium and becomes raw looking and sore, while at the same time the patient complains of a continual salt taste in the mouth. The bowels are usually constipated, but sometimes there is marked diarrhœa, and the stools may contain mucus and blood. Headache, pain in the back and limbs, and vertigo are common from the onset. The patient is usually dull and depressed, and may be very irritable.

Of all these symptoms the most common and characteristic are the peculiar erythematous eruption and some degree of vertigo. It is probable that all pellagrins suffer from some degree of vertigo, and this, combined with an erythematous eruption with the distribution above described, is sufficient to establish a diagnosis of the disease, especially if they show a tendency to periodic exacerbation in spring and remission in winter.

The eruption maintains its erythematous type for some weeks after its appearance and then fades, leaving the skin rough and slightly thickened. The affected parts are usually found to be stained a light brown as the erythema disappears. With the subsidence of the rash, during the first year of the attack at least, all other symptoms may also subside, but it is more common to find that, although the rash and gastro-intestinal symptoms disappear, the patient retains a certain amount of irritability and moroseness beyond the normal. A tendency to vertigo, too, may persist after the acute period of the eruption has passed.

In some cases the nervous symptoms at the onset of the attack may be much more severe than has been indicated. The tongue may be tremulous, and the patient may be troubled with a burning sensation in the palms of the hands and the soles of the feet. The vertigo may be very severe, the patient exhibiting a tendency to fall forwards or backwards, while tenderness in the dorsal region of the spine and exaggeration

of the deep reflexes are also frequently observed. Some patients suffer greatly from sleeplessness, while others are habitually drowsy. The patient frequently complains also of muscular weakness, especially in the legs.

Although at the end of a varying number of weeks all symptoms usually disappear after the disease has first made its appearance, the symptoms return as a rule with increased severity in the following spring or early summer, and after persisting for some months they again subside as autumn and winter approach, only to reappear again next spring or summer. While the exacerbations usually occur in spring or early summer and the remissions in autumn or early winter, this is not always the case, and sometimes after a period of remission in late summer an exacerbation may occur in autumn. This autumn exacerbation is more common after the disease has been established for some years than early in the attack.

As the disease progresses, the patient loses very much in general condition. He becomes thin, melancholy and irritable. The skin in the regions attacked by the rash grows rougher and thicker with each successive exacerbation, and becomes gradually more and more deeply pigmented. Muscular weakness and vertigo increase, and headache and pain in the back may become very acute, especially during the periods of exacerbation. Ultimately, the patient drifts into a condition of melancholia and dementia, and becomes emaciated and helpless, suffering from incontinence of urine and involuntary diarrhœa. Sooner or later most pellagrins drift either into ordinary asylums or into institutions specially provided for the care of these unfortunate people in the later stages of the disease.

The duration of pellagra is very variable. In some cases the patient only survives for two or three years, but in most instances the disease is much more chronic, and may persist for ten or fifteen years, or even longer.

The prominence of the various groups of symptoms is also very variable. In some the gastro-intestinal symptoms predominate; in others the cutaneous symptoms; in others, again, the nervous; but whatever group predominates the

characteristic distribution of the rash is there and the obstinate vertigo. These two symptoms may vary in degree but are always present.

In some cases the mucous membrane of the gums is soft and spongy, and bleeds easily, and it is this type of case that has led to the name of "Alpine scurvy" being given to the disease.

The nervous symptoms may be at times very violent. Epileptiform seizures are not uncommon in the late stages of the illness. Various ocular symptoms may be present, such as amblyopia and diplopia; ptosis and mydriasis are also seen.

As the attack progresses the patient becomes pallid, and a reduction in the number of red cells and in the amount of hæmoglobin is usually evident. Sambon, Terni, Galasescu and Grigorescu have pointed out that a relative increase in mononuclear leukocytes is common, and this is of value in differentiating the eruption of pellagra from other erythematous rashes with which it might be confused. The urine is frequently alkaline, and sometimes ammoniacal, and in advanced cases, albumin and tube casts are often present.

The disease sometimes assumes a very acute form, which rapidly terminates fatally, and such an acute type may be evident from the onset of illness; but an ordinary chronic case proceeding, so far, quietly and uneventfully may one year suddenly assume this acute and malignant form, and the disease may terminate quickly in death.

An attack of pellagra which is acute from the onset usually runs a very short course with a duration of somewhere between a fortnight and three months. The temperature is elevated, the pulse is very rapid, while the patient suffers from severe prostration. The rapidity of the pulse and degree of prostration are quite out of proportion to the height of the fever. The tongue is red and deeply fissured. Stomatitis and pharyngitis are common, and there is evidence of acute catarrh of the whole gastro-intestinal tract. The patient has difficulty in swallowing, suffers from anorexia and nausea, and exhibits a profound degree of muscular weakness. The skin is dark and livid in colour, and the typical erythema and rough skin may be present. Petechiæ are also frequently met with, and

there is a great tendency to the formation of bed sores. The patient may suffer from extreme restlessness and tremor, and convulsions or delirium and tetanic spasms of the muscles are also met with. Towards the end, mania or melancholia and hallucinations are quite common. Loss of control of the sphincters of bladder and rectum frequently precedes death.

Recovery from such primary acute attacks is rare. If recovery does take place it is only temporary, and a fatal termination is the rule. When such an attack occurs in the course of a chronic pellagra, it is invariably fatal.

In a chronic pellagra which runs its course without any definite acute attack, death occurs from gradually increasing prostration and cachexia, and is usually preceded by a condition of muscular and mental weakness so great that the patient lies helpless and practically unaware of his surroundings, and dies ultimately of sheer asthenia.

In young people a type of pellagra is sometimes met with in which the symptoms are confined to a mild dermatitis and slight gastro-intestinal catarrh, and in such cases recovery not infrequently takes place at the end of a year or two, and the patients ultimately grow up into quite healthy adults, and do not show for the rest of their lives any tendency to exhibit the symptoms of pellagra.

The degree of fever in pellagra is very variable. It is unusual to find, except in acute fulminating cases, that the temperature is elevated at the beginning of the attack. There may be perhaps a few days' fever now and again, but pyrexia is not an invariable symptom. During the period of recurrence in successive years a tendency to pyrexia becomes more marked, but the fever is irregular and is frequently quite mild. This irregular pyrexia is the general type throughout the whole course of an attack of the usual more or less chronic type.

Epidemiology.—Until within a very few years ago pellagra was believed to have the most limited geographical distribution of any of the acute specific infections.

For long it had been known to exist in Lombardy, in parts of Hungary, Roumania, France, Spain, and in Egypt,

but the United States of America and Great Britain were supposed to be free from the disease. Within recent years, however, many cases have been described in the United States, more particularly in Virginia, North and South Carolina, Georgia, Alabama, Mississippi, Florida, Louisiana, Kentucky, Tennessee and Texas. According to Roberts, out of forty-nine States, including the district of Columbia, pellagra has originated in thirty-three, and he states that in his belief it is probable that there are 10,000 cases of pellagra in the United States at the present day.

Pellagra has also been discovered in Mexico, the West Indies, Cape Colony, and in certain parts of Northern Africa other than Egypt.

Great interest has been aroused within the past few years by the discovery and description by Sambon and others of undoubted cases of pellagra existing in the British Isles. Several cases have been discovered in the asylums of the north-east of Scotland, and notes on some British cases have appeared in the "British Medical Journal" and the "Lancet," in the summer and autumn of 1913.

On July 5th, Dr. Sambon published in the "British Medical Journal" an interesting history of the disease in England, and gave full notes of several cases. It was through the confirmation by Dr. Sambon of Dr. Box's provisional diagnosis that an interesting family series was discovered. One case died in St. Thomas' Hospital; an elder brother, who seems to have suffered from similar symptoms, had died previously in January, 1911; and a third child is presently living at Slough.

At the request of Dr. Charles W. Kay, of Lymington, Dr. Sambon visited that district and was able to confirm Dr. Kay's diagnosis of pellagra in a patient living in the neighbourhood of Lymington, while Dr. Hammond published in the same number of the "British Medical Journal" some interesting notes of a case who had died in the Isle of Wight, and who had apparently contracted the infection in Scotland. Through the courtesy of Dr. Sambon, the writer was able to study the cases at Lymington and Slough.

In the "British Medical Journal," on July 19th, Dr. Sambon published notes of three other cases occurring in Shropshire, Cardiganshire, and in the County Asylum at Napsbury, and on August 9th Dr. Sambon made references in the "British Medical Journal" to a case in the Prestwich County Asylum, and three more cases at Napsbury. Again, in the "British Medical Journal," on September 27th, Drs. Reid and Calwell published the notes on a supposed case of pellagra near Belfast, and Dr. L. R. Lempriere described a case which he had discovered in Llanidloes, Glamorganshire, which seemed to be a typical case of pellagra.

Several articles also appeared in the "Lancet," notably an excellent article by Dr. Gurth S. Blandy, of Napsbury County Asylum, in which he mentioned the two cases at Prestwich under the care of Dr. J. S. Stephenson, and also nine cases at Napsbury. He also stated in this paper that several doubtful cases were under observation at Napsbury, and he had seen a case which looked like a mild case of pellagra at Hill End Asylum. It is interesting to note that all the cases at Napsbury except one were women, and all were in early middle age. In the same number of the "Lancet" Dr. J. W. E. Cole described a case at Bethnall House Asylum. On October 18th, Dr. Emma M. Johnstone, of Holloway Sanatorium, Virginia Water, contributed to the "Lancet" notes on three probable cases of pellagra, one of which had been under observation in 1911 and two in 1912.

While all these papers were written in the belief that the cases observed were definitely pellagra, and the first case at Napsbury, which through the courtesy of Drs. Sambon and Blandy the writer was permitted to see, appeared undoubtedly to be suffering from an acute specific disease, Dr. W. Rees Thomas contributed a note to the "Lancet," on September 13th, suggesting that the cases described might possibly be cases of drug intoxication, basing his suggestion on the fact that in Italy only some four per cent. of pellagrins were to be found in asylums. The cases at Slough and Lymington, and the first case at Napsbury, all of which the writer has seen, were certainly not cases of drug intoxication, and, while

it may be necessary occasionally to distinguish between true pellagra and a drug eruption, it does not seem likely that any of the cases described in 1913 were drug intoxications, whatever they may have been. It is possible that many cases of melancholia and dementia which are at present inmates of our asylums may be pellagrins in the late stages of the disease.

Pellagra attacks both sexes, but under equal conditions women seem to be more readily infected than men. It attacks people of all ages, from infants to those who have passed the three score years and ten. It is, however, more common among adults in the prime of life than among those at the extremes of age.

Etiology.—Until within very recent years pellagra has been generally supposed to be connected in some way or another with the eating of maize, and just as in the case of rice and beriberi, nitrogen starvation or some infection conveyed by the grain has been thought to be the cause of the disease, and the fact that pellagra occurred so largely in maize eating districts has given a certain colour to this belief. In Northern Italy, Roumania and Spain, where pellagra has been known to exist for so long, the peasants eat maize preparations to the exclusion of other cereals, and a somewhat cursory survey of these maize eating districts would seem to show that pellagra appeared there with fairly uniform distribution. So firmly had this idea taken hold of those who studied pellagra that the Governments of Roumania and Italy instituted special precautions against the possibility of people of these districts eating contaminated or unsound maize; special drying apparatus and Government bake-houses were built, and it is said that since the introduction of these precautions pellagra has decreased, except, curiously enough, in the district of Perugia in Italy, where the disease is on the increase. In association with these precautions taken against the eating of unsound maize, the Governments of Italy and Roumania have also instituted *pellagrosari*, or places for the treatment of pellagrins, and have also paid considerable attention to the better hygienic surroundings of

persons in these districts: however, it must be remembered that all over Northern Italy the last ten years have been a period of great industrial and agricultural progress, so that it is difficult to say how far the improved condition of the maize or the improved general hygiene of the people has been responsible for the decrease in pellagra which is said to have occurred in these regions. The decrease does not seem likely, on the face of it, to have resulted from the supervision of maize alone, particularly as in the district of Perugia no decrease has taken place. Moreover, even in Italy, in certain places in which maize is eaten freely no pellagra is found, as in Venice and all urban districts, where pellagra does not originate, although it may be rife in the immediate vicinity of the cities. Another interesting fact is that in Northern Italy many people have been known to suffer from pellagra who have never eaten maize or any of its derivatives.

Some two years ago Sambon published a paper in the *Journal of Tropical Medicine*, in which he combated the idea that pellagra is due to the eating of unsound maize, and put forward the theory that it was due to some infection by a specific organism not introduced into the body by food, and supported his theory by many interesting observations.

Sambon points out that the comparison of two islands off Venice enables one to draw interesting conclusions with regard to the etiology of pellagra. The two islands are Murano and Burano. The island of Murano has been famous for centuries for the manufacture of glass. All the male inhabitants are glass-makers and glass-blowers, and, while they have extensive communication with Venice, have very little traffic with the mainland. The men in Burano are fishermen, and ply their trade along the shores of the mainland. The women in both islands are lace-makers, and scarcely ever leave home. An exception to this statement is that when Sambon visited the islands there were two women on the island of Burano who were field workers, and did their work on the mainland. On the island of Murano, Sambon found no pellagra, either among men, women or children. On the island of Burano all the men practically were pellagrins, while none of the children were pellagrous, and only the two women who worked

on the mainland. All eat polenta. There was no particular reason to believe that the polenta in Murano was made from better maize than the polenta in Burano, and in any case the distribution of the disease in the island of Burano was so unusual in the fact that so many men and so few women were attacked, that it seemed likely that the men were pellagrous because they had been exposed to an infection to which the women had not been exposed, seeing that if both sexes have an equal chance of taking the disease women suffer more frequently than men.

From the study of the disease in these and other districts Sambon came to the conclusion that it was due to a parasitic infection conveyed, not by food, but possibly through the mediation of some biting insect. In his further studies of the geographical distribution of the disease Sambon found that pellagra was prevalent in those districts which were near rather rapidly moving streams, in districts which were not marsh land, and which were, in short, very different in character from those places in which malaria was rife. In looking for biting insects which might convey the infection Sambon naturally set out to find what biting insects were peculiarly common in such districts, and he found that the insects which were most common were certain species of the *Simuliidæ* or so-called "sand-flies," the larval forms of which inhabit rather rapid streams. The flies are found in large numbers on the stones and the water-plants in such streams.

Pellagra is a disease of the country and not of towns, and this is interesting considering the habits of the *Simuliidæ*, which are strictly not domestic.

The discovery of cases in England is at the present time a matter of extreme interest, and it is difficult to understand how anyone can now hold firmly to the Zeist theory with regard to the causation of the disease. The complete Zeist holds that pellagra is always dūe to an intoxication by maize, and that if a disease resembling pellagra occurs in people who do not eat maize it is therefore not pellagra. The cases in England, none of whom ate maize habitually, and the condition of things already mentioned as obtaining in the

islands of Murano and Burano, go far to shake one's belief in any Zeist theory.

In all the districts in which English cases have appeared, and where investigation has been made, *Simuliidæ* are found in great numbers, and while there is at the present moment no proof that the *Simuliidæ* are the carriers of the infection of pellagra, it would seem likely that all further investigations of this disease will go to prove Sambon's theory that the disease is insect-borne rather than to confirm the Zeists in the position which they have taken up. The Report of the Commission in the United States of America, in whose deliberations and investigations Sambon has taken an interested and active part, and the results of Sambon's own investigations in the West Indies during the autumn of 1913, will be awaited with the greatest interest, and as the summer of 1914 develops it seems more than likely that a sufficient number of cases will be found in England to give us material for interesting and profitable research.

Sambon's theory is that pellagra is due to infection by some protozoal parasite conveyed to the human being by the bite of certain of the *Simuliidæ*, or some similar insect, just as the parasite of malaria is conveyed to the human being by mosquitoes, and his theory is finding at the present day wider and wider acceptance in Italy, and has been most favourably received throughout the United States of America. It is true that at the present moment the identity of the infecting protozoal organism has not yet been thoroughly established, that forms at all suggestive of such a parasite have not been discovered in the *Simulium*, and that experimentally the disease has never been conveyed by the *Simulium* to any animal; but in view of Sambon's careful study of the geographical distribution of the disease and of the interesting facts which he has brought forward to show that so many polenta eating districts are free of the disease, and that so many districts in which no polenta is eaten are pellagrous, his belief seems to be worthy of the most careful consideration, and is suggestive at least of a much more probable causation of pellagra than maize, contaminated

or uncontaminated. The fact that even a few cases have been discovered in the United Kingdom in districts where no maize is eaten is enough to shake reasonable belief in the idea that the disease is conveyed in any way by the eating of maize, and, seeing that pellagra is definitely on the increase in the United States, and is knocking at our own doors, a careful study of its ètiology along the lines which Sambon indicates should be the serious objective of epidemiologists in this country.

Treatment.—The treatment of pellagra has been so far very unsatisfactory. In a certain number of cases, perhaps in a large number of cases, the disease is capable of arrest if the patient is removed in the early stages from a pellagrous district to a place where the disease is unknown, but in removing a patient to a new district care should be taken, in view of the possibility of its being spread by the *Simulium*, that such a district should not be one in which the *Simulium* is found, both for the patient's sake and for the sake of the community.

It is possible that the hypodermic injection of certain of the newer preparations of arsenic, such as salvarsan, neosalvarsan, atoxyl, or the cacodylate of soda, may be of value in the treatment of the disease, especially in its earlier stages. A belief that the disease is due to a form of protozoal infection would render such treatment quite reasonable.

Appendix.

THE SERUM TREATMENT OF TUBERCULOSIS.

In the chapter on Pulmonary Tuberculosis the writer stated that so far the serum treatment of tuberculosis had met with little success. During the past year, however, the treatment of ambulant cases of pulmonary phthisis with a new serum has been undertaken by three members of the staff of Margaret Street Hospital for Consumption (McClure, Barcroft and Thomas). The serum used is the invention of a German physician, and is called "Contra-toxin No. 4 (Mehnarto)." Dr. Mehnarto, in a letter to the "Lancet" on 21st June, 1913, states that the composition of the serum is a mixture of coagulant and hæmolytic snake serum and sheep's blood, the resulting serum having as its objective the conveying of the natural immunity of the sheep to the human being, and also a certain bactericidal effect produced probably by the snake serum.

Sixty-seven cases have been sufficiently long under treatment to warrant certain conclusions being drawn. It is evident that the serum has no disagreeable effects on the human being; no true local or focal reactions have been observed, and any general reaction as expressed by rise in temperature has been so slight as to warrant but little attention. No serum disease has been observed, and even in those cases where the injections were given during the danger period no indications of anaphylaxis have appeared.

The series of cases treated at Margaret Street Hospital was made up of all classes and conditions of pulmonary

phthisis, some of whom had been failures under tuberculin treatment, while certain others had broken down after coming home from a sanatorium. Some of the cases were in a very advanced stage of the disease; about a sixth of the number showed definite signs of cavitation. Both febrile and afebrile cases were treated, and hæmorrhages were not considered as contra-indications to treatment by Contra-toxin No. 4.

After some six months' trial of the serum, we have considered ten cases as "arrested." These were all cases who were in a comparatively early stage of the disease when treatment was begun. Most of the others have shown distinct signs of improvement, both in general condition and physical signs, and even some advanced cases have shown such improvement as to warrant one thinking that an ultimate "arrest" may be possible. Some of the advanced cases were in such a condition of general enfeeblement and suffered from such an active and wide-spread lesion that from the beginning no hope was entertained of anything like "arrest." Certain of these cases have been influenced but little by the treatment, a fact which has caused us no surprise.

The results all over have led us to the conclusion that the serum is worthy of careful and prolonged trial, and it seems likely that in the majority of cases improvement will result from its use. It is indeed interesting to see how in many cases, in spite of home conditions of the most adverse kind, very marked improvement has taken place in a comparatively short time, even in cases who when first seen were in a very unsatisfactory condition both with regard to extent of lesion and deterioration in general health.

Patients of all ages were included in the series, the youngest being ten, and the oldest sixty-five years of age. Out of the sixty-seven cases three died, one from a profuse hæmorrhage before treatment was properly begun; another, who was a highly febrile rapidly advancing case, from asthenia, in spite of carefully regulated and continued treatment and rest in bed; the third, a case of long standing who had had several severe relapses before serum-treatment was begun, died suddenly after suffering from severe dyspnœa for some hours.

The serum is simple of administration. It has been our practice in cases who were afebrile at the commencement of treatment, or who showed only a moderate amount of daily variation in temperature, to begin the treatment by an injection of 5 c.c. of the serum, giving four days later an injection of 10 c.c., and continuing doses of 10 c.c. twice a week until symptoms appeared which indicated that it was wise to lengthen the period between the doses. The indications for lengthening the period between the doses seem to be of two kinds. It has been found that after a varying period of treatment by 10 c.c. twice in the week many cases begin to exhibit a slight daily rise in temperature, and at the same time complain of lassitude and perhaps a little headache. These symptoms we have taken as indicating either that the patient is suffering from an excessive quantity of the serum in the system, or that the interaction of the serum and the tubercle bacilli has resulted in the freeing of an amount of toxin in the patient's tissues too great for his eliminative capacity. This period of slight fever and malaise we have called, in the meantime, "the period of saturation." After this stage has been reached we have found it wise to lengthen the intervals between the doses and even to reduce the doses themselves, and we have noticed that after the intervals between doses have been increased, with or without decrease in the actual quantity of the dose, fever, malaise and headache have disappeared, and the progress of the case thereafter has been even more favourable than before the occurrence of "saturation." In those cases, too, who have shown very marked improvement both in general health and in physical signs, whose condition, in other words, has reached such a stage as to warrant a hope that "arrest" will occur, we have lengthened the interval between the doses and reduced the quantity of each dose.

In cases which were definitely febrile at the commencement of treatment we did not begin with the full initial dose of 5 c.c., but reduced it to 2.5 c.c. to commence with, and continued with doses of 5 c.c., given twice or perhaps only once a week. As fever disappeared it seemed best to increase the dose to 10 c.c., and give it once a week until

either symptoms of saturation appeared or until the improvement of the patient was such as to warrant a reduction of the dose or a lengthening of the interval between the doses. In children below the age of, say, fourteen years it has been found advisable to begin with a dose of 1.5 c.c. and continue with a dose of 3 c.c. once or twice a week, according to the condition of the patient.

The injections are best given between the shoulders, due aseptic precautions being observed, and no inflammatory condition has been noted in the large number of injections which have been given. A certain amount of pain and stiffness in the back is usual after the first few doses; this may last for two or three days at the commencement of treatment, but as more injections are given all that the patient complains of is a little stiffness, and perhaps slight pain of a few hours' duration on the evening following the injection.

The effect on the sputum and cough is interesting. The sputum is as a rule definitely increased after a few days, and at the same time it becomes distinctly more bronchial in character. At this period cough is also increased, but is not usually violent or distressing. The sputum then gradually decreases in amount, and as the amount of sputum lessens it is common to find that the patient suffers from a rather dry, irritating cough, which may disturb his sleep. This irritating cough, however, is easily subdued by giving some linctus of heroin at night, and by getting the patient to spray his throat well with menthol two or three times a day, and to use a menthol ointment for the nose night and morning.

Dr. White Robertson, who has acted as bacteriologist during the treatment of the series of cases at Margaret Street Hospital, conducted a careful bacteriological examination of the sputum, and has also estimated the leukocytes in the blood, classifying them according to Arneth's method. As improvement takes place, the first thing that has been noticed in the sputum is that phagocytosis becomes active, so that few free bacilli are seen in the field, the others being contained in phagocytic cells. At the same time the bacilli have been observed to lose their acid-fast character, and to show a tendency to granulation and degeneration. The

counting of the leukocytes after Arneth's method has in Dr. Robertson's hands proved of great interest in the observation of these cases. As a general rule improvement in the leukocyte count has been *pari passu* with improvement in the clinical manifestations. In a few cases improvement in the leukocyte count came before any improvement in physical signs or general condition had taken place, and one was able to take a hopeful view of the case, although at the moment the physical signs did not warrant this attitude. In other cases a rapid improvement in physical signs was associated with no improvement, or perhaps even a deterioration, in Arneth's count, and this was frequently the case when the patients had quite definitely reached the period of "saturation." The probable explanation of this fact is that the patient was suffering from an increased toxæmia, due to a rapid and extensive destruction of tubercle bacilli and absorption of tuberculous tissue. Regulation of the dose in all such cases resulted in rapid improvement in the leukocyte count.

The observation of the opsonic index in certain of the patients under treatment gave some interesting results. The opsonic index rose rapidly to above normal, a rise of from .8 to 2.2 being noted in one case in a fortnight, and after the initial rise to very much above normal the index fell to slightly above normal, at which level it was maintained. The doses in the cases in which the opsonic index was estimated were given only once a week, and the blood was always taken immediately before the dose.

The simplicity of its administration and the lack of any focal reaction would seem, from the observations already made, to give Contra-toxin a certain advantage over tuberculin, but, as in the case of all other forms of treatment used for pulmonary tuberculosis, it should not be relied on entirely, but other conditions must be taken into consideration. The care of the teeth, the rest of febrile cases, improvement in home surroundings, and reasonable feeding, are just as necessary where Contra-toxin is given as where any other form of treatment is employed.

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